

Western  Graduate&PostdoctoralStudies

Western University  
**Scholarship@Western**

---

Electronic Thesis and Dissertation Repository

---

6-1-2017 12:00 AM

# Examining the Influence of Demographic Differences on Children's WISC-V Test Performance: A Canadian Perspective

Sarah E. Babcock  
*The University of Western Ontario*

Supervisor  
Dr. Donald Saklofske  
*The University of Western Ontario*

Graduate Program in Psychology  
A thesis submitted in partial fulfillment of the requirements for the degree in Master of Science  
© Sarah E. Babcock 2017

Follow this and additional works at: <https://ir.lib.uwo.ca/etd>

 Part of the [Personality and Social Contexts Commons](#)

---

## Recommended Citation

Babcock, Sarah E., "Examining the Influence of Demographic Differences on Children's WISC-V Test Performance: A Canadian Perspective" (2017). *Electronic Thesis and Dissertation Repository*. 4555.  
<https://ir.lib.uwo.ca/etd/4555>

This Dissertation/Thesis is brought to you for free and open access by Scholarship@Western. It has been accepted for inclusion in Electronic Thesis and Dissertation Repository by an authorized administrator of Scholarship@Western. For more information, please contact [wlsadmin@uwo.ca](mailto:wlsadmin@uwo.ca).

## **ABSTRACT**

Intelligence is a powerful correlate of human behaviours and characteristics, and has an important impact on many life outcomes including educational and career success, mental health, and longevity. Given the widespread influence, it is imperative that intelligence and intelligence tests are interpreted accurately. The purpose of this study is to examine the influence of demographic differences on the intelligence test scores of Canadian children using the WISC-V. Drawing from the WISC V<sup>CDN</sup> standardization data, the results suggest that ethnicity and socioeconomic status are significant predictors of IQ scores, and that differences in these variables significantly affect test performance. Further, there is some evidence that socioeconomic status acts as a mediator in the relationship between ethnicity and IQ. Given the use of the WISC-V across Canada, the results are not only important for interpretation of the test scores, but also provide valuable insight for Canadian psychological and education communities.

*Keywords:* Assessment; Intelligence; WISC- V; Demographics; Canadian Norms; Children & Adolescents

## ACKNOWLEDGMENTS

First and foremost, I thank my supervisor **Dr. Don Saklofske** for his guidance and encouragement. From the initial planning stages to the final draft, his expertise, feedback, and support have been invaluable to my success. Don, thank you for being the kind of supervisor who has the faith in me, even when I might not. Your dedication and mentorship does not go unnoticed.

I also extend my sincerest thanks to **Dr. Paul Tremblay** for his tremendous support and statistical guidance. Paul, I am grateful for the knowledge and skills that you have shared, and consider myself lucky to have had the privilege of learning from you.

To my mentor and friend **Dr. Jessie Miller**, I am thankful for your dedication to preparing me as a researcher, and for sharing your expertise in support of my goals. Your calming reassurance through my moments of imposter syndrome are so appreciated.

I thank the research team at **Pearson** for their willingness to share the WISC-V<sup>CDN</sup> data. Without their collaboration, this project would not have been possible.

To **Dr. Jason Brown**, **Dr. Paul Tremblay**, and **Dr. Tony Vernon**, thank you for lending your expertise to serve on my examination committee. I sincerely appreciate the time and energy that you have dedicated to my project.

To my cohort allies, **Alexa Rempel** and **Jessica Padgett**, I thank you for your friendship over these past two years. I consider the bond we've developed a remarkable gift. Alexa, I am especially grateful for your comforting words in my many moments of insecurity; I could not have made it without you. Jessica, a special thank you for your editorial feedback. Your dedication of time and expertise to helping me communicate my ideas is so appreciated. You not only provided invaluable feedback, but made the writing process much less challenging by being such a great friend.

I also thank the close friends I have made in the program, most especially **Claire Wilson**, **Yixian Li**, **Rachel Plouffe**, and **Sarah Moroz** for their comradery and support. A special thanks to Claire for taking me under her wing in those first few months; graduate school would have been a much scarier place without you.

Finally, I am grateful for the support of my family. To my parents **Robert** and **Diana**, who have never wavered in their pride and support – thank you. I am so lucky to have been blessed with parents who valued and encouraged my curiosity and love of learning. Thank you for supporting me every step of the way; none of this would have been possible without you. Last, but not least, to “my baby” brother **Matthew**, thank you for being my biggest fan. Your support has never gone unnoticed, and your silliness in my most stressful times was so often just the thing I needed.

## TABLE OF CONTENTS

ABSTRACT .....	ii
ACKNOWLEDGEMENTS .....	iii
TABLE OF CONTENTS .....	iv
LIST OF TABLES .....	viii
LIST OF FIGURES .....	ix
LIST OF APPENDICES .....	x
CHAPTER 1: INTRODUCTION	
1. Introduction .....	1
1.1 <i>Intelligence and the Human Experience</i> .....	2
1.1.1 <i>Career Success and Academic Achievement</i> .....	3
1.1.2 <i>Psychological Health and Well-Being</i> .....	5
1.1.3 <i>Physical Health and Longevity</i> .....	6
1.1.4 <i>Societal Implications</i> .....	7
1.1.5 <i>Summary</i> .....	8
1.2 <i>Genetic and Environmental Influences on Intelligence Expression</i> .....	8
1.3 <i>Examination of Demographic Influences on Test Performance</i> <i>in the U.S.</i> .....	13
1.3.1 <i>The WISC-V U.S. Post-Standardization Analysis</i> .....	14

<b>1.4 The Use of the WISC-V<sup>CDN</sup></b>	17
1.4.1 The Wechsler Legacy	17
1.4.2 Distinct Canadian Norms	18
1.4.3 Representing the Current Canadian Population	19
<b>1.5 Rationale</b>	20
<b>1.6 Objective</b>	21
<b>1.7 Hypotheses</b>	21

## CHAPTER 2: METHOD

<b>2. Method</b>	23
<b>2.1 Participants</b>	23
2.1.1 Inclusion of Children from various Disability Classifications in the Sample	25
2.1.2 Inclusion of Children from Special Education Classifications in the Sample	27
<b>2.2 Measures</b>	28
2.2.1 Wechsler Intelligence Scale for Children: Canadian – Fifth Edition (WISC-V <sup>CDN</sup> )	28
2.2.2 Home Environment Questionnaire	29
<b>2.3 Study Variables</b>	29
2.3.1 Full Scale IQ	29
2.3.2 Parent Education Level (PED)	30

2.3.3	<i>Combined Annual Income</i>	30
2.3.4	<i>Ethnicity</i>	30
<b>2.4</b>	<b><i>Procedure</i></b>	<b>31</b>
2.4.1	<i>Developing the Study Matrix</i>	31
2.4.2	<i>Examiners</i>	32
2.4.3	<i>Enrolment and Collection</i>	33
2.4.4	<i>Administration</i>	34
2.4.5	<i>Special Group Eligibility</i>	34
2.4.6	<i>Sample Accuracy</i>	35
2.4.7	<i>Scoring and Data Entry</i>	35
<b>2.5</b>	<b><i>Data Analytic Strategy</i></b>	<b>36</b>

## CHAPTER 3: RESULTS

<b>3.</b>	<b>Results</b>	<b>38</b>
3.1	<i>Data Screening</i>	38
3.2	<i>Analyses</i>	39
3.2.1	<i>Parent Education Level and FSIQ</i>	39
3.2.2	<i>Ethnicity and FSIQ</i>	41
3.2.3	<i>Examining the Interaction between Ethnicity and Parent Education</i>	42
3.2.4	<i>Ethnicity, Parent Education, and Income as Predictors of FSIQ</i>	45

3.2.5	<i>SES as a mediator in the relationship between ethnicity and FSIQ .....</i>	47
3.2.5.1	<i>PED as the Mediator.....</i>	48
3.2.5.2	<i>Income as the Mediator .....</i>	49
3.2.5.3	<i>PED and Income as Mediators.....</i>	50
 <b>CHAPTER 4: DISCUSSION</b>		
4.	<b>Discussion .....</b>	52
4.1	<i>The influence of Socioeconomic Status on Children’s FSIQ.....</i>	52
4.2	<i>Ethnicity Differences in FSIQ Scores .....</i>	54
4.2.1	<i>Test Bias.....</i>	55
4.2.2	<i>Considerations of Ethnicity differences .....</i>	56
4.3	<i>The Dynamic Interaction between Parent Education Level and Ethnicity.....</i>	57
4.4	<i>Summary .....</i>	58
4.5	<i>Strengths .....</i>	59
4.6	<i>Limitations and Future Directions.....</i>	61
4.7	<i>Final Conclusions and Implications .....</i>	63
<b>REFERENCES .....</b>		65
<b>APPENDICES .....</b>		75
<b>CURRICULUM VITAE.....</b>		90

## LIST OF TABLES

<b>Table 1.</b>	Parent Education Level (PED) Categorization and Percentage in Sample.....	24
<b>Table 2.</b>	Percentages of the Normative Sample and Canadian Population by Disability Type Classification.....	26
<b>Table 3.</b>	Mean FSIQ of Children by Parent Education Level.....	39
<b>Table 4.</b>	Mean FSIQ of Children by Ethnicity.....	41
<b>Table 5.</b>	Children's Mean FSIQ by Ethnicity and Parent Education Level.....	43
<b>Table 6.</b>	Summary of Standard Regression Analysis to Predict FSIQ from Ethnicity, Parent Education, and Income.....	46



## LIST OF FIGURES

<b>Figure 1.</b>	Mean FSIQ scores with 95% CI for each PED level group.....	40
<b>Figure 2.</b>	Mean FSIQ with 95% CI for each ethnicity group.....	42
<b>Figure 3.</b>	Children's FSIQ scores by parent education level and ethnicity.....	44
<b>Figure 4.</b>	Path diagram of parent education level as a mediator in the relation between ethnicity and FSIQ.....	49
<b>Figure 5.</b>	Path diagram of income as a mediator in the relation between ethnicity and FSIQ.....	50
<b>Figure 6.</b>	Path diagram of parent education and income as mediators in the relation between ethnicity and FSIQ.....	51

## **LIST OF APPENDICES**

<b>APPENDIX A.</b>	Demographic Characteristics of the full Standardization Sample...	75
<b>APPENDIX B.</b>	Content and Structure of the WISC-V <sup>CDN</sup> .....	76
<b>APPENDIX C.</b>	WISC-V <sup>CDN</sup> Home Environment Questionnaire (HEQ).....	78
<b>APPENDIX D.</b>	General Inclusion Criteria.....	88
<b>APPENDIX E.</b>	Specific Inclusion Criteria for Special Groups.....	89

## CHAPTER 1: INTRODUCTION

### 1. Introduction

Intelligence is the ability to acquire and use knowledge and skills, and is the cognitive foundation utilized and built upon everyday to live, grow, learn, and function. Intelligence is also one of the most fundamental individual differences that exists, and a powerful correlate of a wide variety of human behaviours and characteristics (Gottfredson, 2002; Neisser et al., 1996). Research across an array of disciplines has demonstrated the important implications of intelligence for a variety of life outcomes such as educational achievements, career success, psychological and physical health, and socioeconomic status. Given this widespread influence of intelligence on childhood success, as well as later life outcomes in adulthood, it is imperative that intelligence and intelligence scores are interpreted appropriately.

A comprehensive and accurate understanding of intelligence and the ‘data’ that are derived from intelligence tests is therefore critical for guiding and ensuring healthy childhood cognitive development and for promoting overall life success. An important aspect in successfully understanding intelligence is to consider the context in which it develops and occurs and thus, environmental and demographic influences need to be incorporated into our interpretation of test scores. However, most of the research examining these factors has been done exclusively with the American population, therefore there is a large gap when it comes to understanding the impact of these variables in the Canada. Given both the subtle and more major social, cultural, and economic differences between these countries it is important that we do not conflate

populations, examining this specifically within the Canadian sample. The current study will extend the examination of demographic differences (specifically, socioeconomic status and ethnicity) on intelligence completed with U.S. samples, providing valuable insight on these patterns for the Canadian population. Further, it is important to consider how environmental differences impact expression of intelligence, specifically, the role that the parent plays. Therefore, this study will broaden the knowledge for Canadian researchers and clinicians, allowing for more informed consideration of these factors in practice. These findings have important implications for the broader concepts of equal access to education and the Canadian education system.

Before examining the literature in depth, an important clarification is necessary regarding the terms *intelligence* and *cognitive ability*. These terms are directly related and intertwined, often used interchangeably in the literature; however, they are not conceptually identical. Intelligence refers to the idea of *capacity* for knowledge and learning, whereas cognition is conceptualized as the *process* or *method* by which learning and integration of knowledge takes place. Intelligence therefore encompasses cognition (Neisser, 1979). These terms however are often used synonymously by researchers and as such, the literature presented will be described using both terms. Further, while both terms are used in the current study, this research examines the influence of factors on intelligence *test scores*, and both terms should be taken to refer to that specific outcome.

### ***1.1. Intelligence and the Human Experience***

The importance of intelligence cannot be understated. The influence of intelligence spans a multitude of life outcomes including educational achievements and

career success, psychological and physical health, and socioeconomic status. Further, childhood intelligence has direct implications for the immediate success and well-being of the child during development, as well as long-term implications for adulthood. Therefore, understanding intelligence and intelligence scores in childhood is critical.

### *1.1.1 Career Success and Academic Achievement*

Evidence consistently shows that higher intelligence is linked to increased educational accomplishments and subsequent career success (Deary, Whiteman, Starr, Whalley, & Fox, 2004; Gottfredson & Saklofske, 2009; Kuncel et al., 2010). This suggests that individuals who achieve higher levels of education through more efficient learning and/or better performance in school will ultimately attain better employment. Indeed, longitudinal research confirms cognitive ability as the single strongest correlate of academic and workplace success (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007).

The importance of cognitive ability in academic success is also well documented (see Gottfredson, 2002). It is generally agreed that a moderate to strong correlation between cognitive ability and educational achievement exists in children and adolescents. Findings suggest that this correlation ranges between .40 and .70 (Jencks, 1979, p. 102; Jensen, 1969; Neisser et al., 1996; Sternberg, Grigorenko, & Bundy, 2001). This evidence spans a variety of culturally and developmentally diverse study samples, showing general intelligence to be both integral to educational success and a reliable predictor of academic achievement. Laidra, Pullmann, & Allik, (2007) examined 3,600 Estonian students across grades 2-12 with a measure of general intelligence (Raven's Standard Progressive Matrices; Raven, 1981) and a personality measure (NEO-FFI; Costa & McCrea, 1992).

Across all grades, intelligence was the strongest predictor of GPA. Moreover, a prospective longitudinal study conducted by Deary, Strand, Smith, & Fernandes (2007) studied 70,000 English children over a five-year period, examining the association between intelligence (Cognitive Abilities Test; Thorndike, Hagen & France, 1986) at age 11 and later achievement in national exams at age 16. The correlations between the CAT's *g* factor and *all* subject scores were positive, ranging from .43 to .72, with medium to large effect sizes. The overall correlation between the latent traits of ability and educational performance was found to be .81.

The strength of the intelligence and academic achievement relationship is well documented across elementary and secondary school samples; however, the literature suggests that it is weaker in the post-secondary students (O'Conner & Paunonen, 2007; Chamorro-Premuzic & Furnham, 2005). One potential explanation for this is that the criterion used to denote academic achievement shifts over time, moving away from specific cognitive abilities towards personality and motivation variables (Ackerman, Bowen, Beier, & Kanfer, R., 2001). Moreover, it seems reasonable to posit that at higher education levels the effects of intelligence have predominately been accounted for by the selection/admissions standards. Therefore, there is less variability in this sample in terms of intelligence, and individual differences in personality and motivation primarily drive the academic achievement outcomes. Thus, it is not cognitive ability that is deteriorating, nor the relationship between it and achievement, but rather, intelligence is less used as a marker of achievement in later years. However, the child and adolescent sample is the focus of the current research, where this relationship is consistently observed to be strong.

### *1.1.2 Psychological Health and Well-Being*

There is also considerable evidence documenting the association between intelligence in youth and the risk of mental health concerns in adolescence and adulthood. Lower IQ in childhood has been linked to the increased risk of depression, post-traumatic stress, and schizophrenia in later life (Zammit et al, 2004; Gale et al., 2008). When these studies are adjusted for measures of socioeconomic status (SES), the effect sizes in most cases were reduced, however majority continue to show this relationship. Research also suggests that higher cognitive ability in childhood may serve as a protective variable against problematic internalizing symptoms (e.g., depressive disorders, anxiety disorders) that can arise in adolescence. However, results vary by the child's gender. A child with high cognitive ability may also be able to attenuate the negative effects of family dysfunction and chronic illness on later mental health issues better than a child with low cognitive ability (Weeks et al., 2014). Beyond adolescence, there are also longterm psychological implications (Wraw, Deary, Der, & Gale, 2016; Wrulich et al., 2014). In one example, Wraw et al., (2016) focused on the link between intelligence at age 15-23 years and mental illness (depression, anxiety, sleep difficulties, etc.) at age 50. They found higher intelligence was significantly associated with reduced risk of most self-reported mental health outcomes, apart from depression.

Importantly, adjusting for adult SES tends to account for a significant proportion of the observed association between IQ and the mental health outcomes. Overall, intelligence is influential as both a disarming and a protective factor for many negative later-life psychological outcomes. However, it is important to also clearly consider the influences of SES as this tends to be a strong mediator in that relationship. The evidence

suggests that SES is an important variable to consider when examining the relationships between intelligence and other factors, particularly academic achievement and psychological well-being. However, while important, the influence does not seem to be as strong in physical health outcomes, as discussed below.

### *1.1.3 Physical Health and Longevity*

Intelligence is also a significant factor in physical health and is linked with many health behaviors and outcomes, both positive and negative. Higher intelligence is related to physical fitness, a preference for low-sugar/fat diets, and longevity, while lower intelligence is linked to alcoholism, infant mortality, smoking, and obesity (Gottfredson & Deary, 2004). One data set integral to examining this relationship was the Scottish Mental Surveys (SMS) of 1932 and 1947 which provided the baseline data for follow-up studies examining relationships between childhood IQ and later physical health. In one such follow-up study, Whalley and Deary (2001) identified children who participated in the SMS-1932 ( $N=2,792$ ) and traced 2,230 (79.9%) of those children who participated in the initial assessment. Examination showed that IQ at age 11 had a significant association with survival until about age 76. On average, individuals at a 1-standard-deviation (15-point) disadvantage in IQ (relative to other participants) were only 79% as likely to live to age 76. The effect of IQ was stronger for women, however authors believed the difference was likely influenced by increased fatality for males, particularly high IQ males, during World War II. Use of this data set also showed a 1-standard-deviation drop in IQ was significantly associated with a 27% increase in cancer deaths among men and 40% increase among women (Deary, Whalley, & Starr, 2003).



Once, again, SES may play a role in this relationship, as it was especially pronounced for stomach and lung cancers, which are associated with low SES in childhood. These longitudinal datasets demonstrate that intelligence in childhood contributes significantly to differences in later morbidity and mortality, and that these relations remained even once the influence of SES was controlled for. One explanation of this relationship posited by Gottfredson & Deary (2004) is that intelligence enhances the individuals' self-care behaviours associated with their health, because it signifies learning, reasoning, and problem-solving skills that are useful in preventing chronic disease and accidental injury, as well as following treatment regimens.

#### *1.1.4 Societal Implications*

Beyond the individual, one's intelligence has significant implications for the community they belong to. Regions where the population has a higher average IQ demonstrate more overall technological and economic progress (Burhan, Mohamad, Kurniawan, & Sidek, 2014; Lynn, 2012), as well as increased levels of innovation and scientific discovery (Rindermann, 2012; Squalli & Wilson, 2014). Specifically, a large-scale study by Rindermann and Thompson (2011) compared the influence of the mean, upper and lower level IQ groups of 90 countries on the gross domestic product of the country. They found that cognitive ability is highly relevant for national wealth, particularly in areas of science, technology, engineering, and math. Thus, implications of a person's intelligence can be grouped with those in their society, influencing growth far beyond the individual person, having widespread effects.

### *1.1.5 Summary*

Overall, the evidence clearly shows that intelligence plays an integral role in childhood and adolescent academic success, directly influencing the performance and abilities that the child exhibits. Intelligence also appears to provide a protective barrier against a variety of childhood and adolescent psychological distresses. Beyond childhood outcomes, intelligence at a young age is linked with a variety of lifelong psychological, physical, and social outcomes. Given this significant influence it is imperative that intelligence assessments are interpreted accurately. This ensures that researchers and clinicians are properly identifying cognitive difficulties at an early age so that they might provide appropriate interventions and support as early as possible.

## ***1.2 Genetic and Environmental Influences on Intelligence Expression***

Given the centrality of intelligence to various aspects of health and wellbeing, it is important that the factors that influence its development and expression are understood. Genetics are unquestionably a predominant factor in the causal foundation and expression of an individual's intelligence. Jensen (1969) thoroughly explored this connection by systemically researching Charles Spearman's (1927) seminal concept of the "general factor of intelligence", also referred to as "g". Jensen's work purported that *g* loads highly on heritability coefficients, meaning the amount of variation we see in intelligence within the population can be attributed to genetic variation. He also noted race differences in IQ scores, and in his later work (1998) explored the biological correlates of *g* and its heritability and predictive power. Inspired by Jensen's work, researchers

continued to explore group differences in IQ scores, including race (see Rushton, 1996; Vernon, 1969) documenting consistent group differences in performance but offering many possible differing explanations and correlates.

Large-scale twin studies and familial studies of intelligence are particularly helpful in understanding the respective influence of genetic and environmental influence on intelligence. A systematic review by Bouchard & McGue (1981) summarized the findings of 111 studies from around the world that examined familial resemblances in measured intelligence. Overall, findings suggested that the pattern of average IQ correlations increases with the degree of genetic similarity. This is consistent with the theory of polygenic inheritance, which states that the higher the proportion of genes two family members have in common, the higher the similarity between their IQ. There was however heterogeneity of the correlations evident within the familial groupings, and this was not moderated (as hypothesized) by sex of familial pairing or by type of intelligence test used. Therefore, while correlation results are consistent with the polygenic theory, this does not discount the importance of environmental factors. For example, the data showed that the monozygotic twins that were reared apart were far from perfectly correlated, that dizygotic twins were shown to be more similar than other biological siblings, and that adoptive parents' IQ's demonstrate a consistent relation with the IQ's of their adopted offspring. Therefore, this data clearly suggests the operation of environmental effects alongside a strong genetic influence.

While tremendously valuable, examining the specific genetic and biological components of intelligence is not the intended focus on the current study, and has already been explored and discussed at length (for example, see Plomin & Petrill, 1997; Wickett,

Vernon, & Lee, 2000; Vernon, 1993). The theme of this study is those ‘exogenous’ factors that appear to be critical determinants underlying the development and individual differences in intelligence. Thus, there is an important need to outline the environmental contexts that are shown to influence cognitive ability. Despite its heritability, intelligence is not rigidly unalterable, and environmental experiences are a vital factor in the overall picture (Gottfredson, 1994; Jensen, 1969). A child’s environment can have both enriching and inhibiting effects on cognitive development and expression of intelligence. Thus, by better understanding how environment and demographic differences influence IQ, we may be able to develop more effective approaches to counteract these negative environmental factors.

In 1994, Gottfredson published a public notice, endorsed by a group of highly respected psychologists, in the Wall Street Journal to present reasoned and informed public information regarding the nature, origins, and practical consequences of individual and group differences in intelligence. This overview articulates environmental and societal influences on IQ and discusses the stability of within group differences. One finding is that members of the same family can and will differ in intelligence for both genetic and environmental reasons. Biological brothers and sisters share exactly half their genes with each parent and, on average, only half with each other, which accounts for some of their differences in IQ, but differences can also be explained by environmental experiences, even within the same family (Hetherington, Reiss, & Plomin, 1994). Further, it notes that individuals are not born with fixed IQs, though IQ does show good stability over time, often stabilizing in childhood without dramatic changes afterwards, barring for example, dementia or injury and disease effecting the brain (Clarke & Clarke, 1984;

Jones & Bayley, 1941; Moffitt, Caspi, Harkness, & Silva, 1993; Sternberg & Grigorenko, 1996). Therefore, the early childhood experience is particularly important for determining several later life outcomes that are related to intelligence. Further, genetic differences in intelligence are not necessarily permanent, just as environmental influences have the potential to become permanent (e.g., from exposure to poison or severe neglect). It is promising that even though both genetic and environmental influences can be irreversibly damaging, they may also be preventable. These findings are consistent with the bioecological model proposed by Bronfenbrenner, & Ceci (1994), which states that a trait can be both highly changeable as well as highly heritable. An example of this is the inherited disorder Phenylketonuria (PKU), which causes the amino acid phenylalanine to build up in the body. It is caused by a defect in the gene that helps create the enzyme needed to break down phenylalanine; lacking this enzyme results in a dangerous buildup when a person with PKU eats foods that are high in protein, ultimately leading to serious health problems. While an inherited genetic disorder, if screened for and identified early, the diet can be modified accordingly to prevent the health problems and build up that would have resulted from the disorder. Therefore this is an example of a situation where heritability is high, but the environment can still exert a powerful influence.

In a further large-scale examination conducted by Neisser et al. (1996), intelligence was meticulously assessed with respect to the correlates of intelligence and the environmental influences. Environment was shown to have significant influences on intelligence that can occur at both the population and individual level. For example, cultural environment shapes how people live and what they value. This affects how individuals approach and value education, how learning is encouraged, and how verbal

skills are used by children in the classroom and at home. Further, children with higher test scores tend to have better education. If a child begins school performing well, they are likely to get better grades, more encouragement from teachers, and have increased learning opportunities. This feedback then perpetuates further cognitive growth of the child and increases the likelihood they will pursue further education. Another strong environmental factor is children's SES and household income level. SES is operationalized in different ways depending on the researchers, but it is broadly defined as the combined total of an individual's or family's economic and social position in relation to others, based on three primary indicators: income, education, and occupation. From a functional perspective, having financial stability increases the likelihood that the child will be exposed to new opportunities and experiences that support cognitive growth. Demonstrated in a study by Schmitt, Sacco, Ramey, Ramey, & Chan (1999), changes in parental employment status can have a strong and significant affect on children's academic performance. Further, children of more privileged families are more likely to attain higher social status compared to those whose parents are poorer and less educated.

These environmental influences on intelligence performance are not particularly surprising when thoughtfully considered. They are an important consideration, because even if a child is intellectually gifted, it has been well established (e.g., McVicker Hunt, 1961) that without early environmental opportunity, including nurturing parents and caregivers, access to quality education, encouragement for engaging in intellectual and creative activities, etc., children's cognitive growth will be restricted. Further, the role of the parent in the child's cognitive development is paramount, and can have both positive and harmful influences to development. Karbach et al. (2013) examined the incremental

validity of parental involvement over cognitive abilities in the prediction of academic performance in math and reading and reported that parental involvement was significant in influencing their children's achievement even after intelligence had been accounted for.

It is clear from the literature that cultural differences, home and community environments, as well as parental support and nurturing play significant roles in the development and expression of intelligence. It is therefore imperative that these external factors are better understood in terms of their influence on the interpretation of intelligence scores. Further, the evidence suggests that while IQ is not entirely fixed, the stabilization of intelligence expression occurs in childhood. This articulates the need to better understand these influences in childhood, as is the focus of this current study, where there is an important window of opportunity for development and support.

### ***1.3 Examination of Demographic Influences on Test Performance in the U.S.***

One way that environmental influences on intelligence can be studied is to examine the role of demographic variables with regards to intelligence test performance, using a countrywide study of children's intelligence. The Wechsler group of intelligence assessments are good candidates for this kind of study as they are multi-factorial measures of ability and have been standardized and normed on large-scale nationally representative samples of children and adults. They are some of the most commonly used intelligence tests in North America, and have been adapted for use in many languages across various countries. Therefore, the normative samples created for these assessments are ideal for examining influences of individual differences on intelligence.

Examining the intricate dynamics of group differences has been explored at length in many Wechsler assessments by the U.S. research teams in collaboration with experts in the field. This began with an evaluation of the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV; Wechsler, 2004). In a post-standardization analysis of the data, Weiss, Saklofske, Prifitera, & Holdnack (2006) examined IQ score differences in relation to race, socioeconomic status, and parental factors (e.g., high school completion, single parent home). They found that while there were not significant biases in the test items or structure, there were real environmental differences observed in the data. Specifically, they observed evidence of mean score differences in IQ based on race and socioeconomic status. These findings prompted an examination of the racial disparities that exist in education, income, poverty status, as well as physical and mental health. This examination has since been applied to subsequent Wechsler assessments, including the Wechsler Adult Intelligence Scale – Fourth Edition (WAIS-IV; Wechsler, 2008) and the Wechsler Intelligence Scale for Children – Fifth Edition (WISC-V; Wechsler 2014). This multilevel approach examining the role of cultural, social, and environmental factors is very useful for understanding the impact of the societal context on test performance.

### *1.3.1 The WISC-V U.S. Post-Standardization Analysis*

As previously mentioned, the WISC-IV findings served as an inspiration for further examination. Of particular importance was the post-standardization analysis of the WISC-V standardization scores conducted by Weiss et al. (2015). This study evaluated the influence of demographic factors on IQ performance differences among U.S. children and appears in a chapter of *WISC-V assessment and interpretation: Scientist-practitioner perspectives* (Weiss, Saklofske, Holdnack, & Prifitera, 2015). In alignment with the



WISC-IV study, authors also review relevant issues surrounding racial disparities, and discuss cognitive development in relation to home, environment, and culture.

The study was conducted using analysis of variance techniques and regression modelling to examine the influence of key demographic factors (race/ethnicity, parent education, and income) on differential IQ performance. First, authors examined the mean FSIQ of children by level of parent education in six categories: *8 years or less, 9–12 years, no diploma, High school diploma/GED, Some college or technical school/associate's degree, Undergraduate degree or more, Graduate degree (at least one parent with a graduate degree)*. Results showed an increase in FSIQ at every educational category. Further, while the mean FSIQ was similar for both categories with less than high school ( $M=87.8$  and  $M=88.6$ ), each additional level increase in parent education resulted in a significant jump in mean FSIQ score. These differences are meaningful; there is a 22.9-point difference in FSIQ between the lowest ( $M=87.8$ ) and highest ( $M=110.7$ ) education levels, and the difference between the children of a college graduate ( $M=108.04$ ) versus a high school diploma/GED ( $M=93.8$ ) is 14.2 points.

Next, race/ethnic differences were examined. The results showed that mean composite scores differed significantly by racial/ethnic group, with the largest mean difference observed between the Asian and African American (AA) groups being more than a full standard deviation apart ( $M=16.7$ ). Additional significant FSIQ differences were observed; the White/AA difference was 11.6 points, and the White/Hispanic difference was 9.1 points.

The study then examined the role of SES as a mediator in the race/FSIQ relationship, comparing results between two race groups at a time. The first analysis was conducted with AA/White comparison. In model 1, FSIQ was regressed on race. Race accounted for 8.9% of the variance in FSIQ score. In model 2, parent education was introduced as a mediator to examine the reduction in variance accounted for by racial group after controlling for parent education. Parent education alone accounted for 17.6% of the variance in FSIQ between the AA and White samples, substantially larger than the variance accounted for by race alone (8.9%). Further, controlling for parent education level reduces the amount of variance in FSIQ attributed to race alone by 61.8% (from 8.9% to 3.4%). Parent education is only one indicator of SES, therefore in model 3 household income was introduced as an additional mediator together with parent education. Income explained an additional 3.2% of the variance in FSIQ between groups after controlling for parent education. Taken together, these two indicators of SES explain 20.8% of the variance in FSIQ scores. Therefore, controlling for both parent education and income reduces the variance attributed to race alone by 78.8%, leaving only 1.9% of the variance accounted for by race alone. This analysis was then repeated for Hispanic and White samples, and similar results were observed. Model 1 showed that race accounted for 3% of the variance in scores between groups. Model 2 showed that parent education alone accounts for 17.1% of the variance, and controlling for parent education reduces the variance in FSIQ accounted for by ethnic group by 96.7%. In model 3, parent income contributed an additional 1.7% of variance in FSIQ scores, reducing the variance explained by ethnicity by 98.6%.

These findings are useful when trying to understand the contextual influences on intelligence performance, and served as the inspiration for the present study. While extensive research has focused on these factors on IQ performance as it pertains to the American population, there has been little evaluation in the Canadian context. The results demonstrated by the examination of the U.S. WISC-V standardization data provided the rationale and foundation for the current study hypotheses. Exploring these relationships within the Canadian context is therefore the intended focus of this research study.

#### ***1.4 The use of the WISC-V<sup>CDN</sup>***

##### ***1.4.1 The Wechsler Legacy***

The choice to use the Canadian Wechsler Intelligence Scale for Children – Fifth Edition (WISC-V<sup>CDN</sup>; Wechsler 2014b) as the measure of intelligence for this study is a multifaceted one. First off, historically the Wechsler family of assessments has a long legacy of use in both research and in practice (Flanagan & Kaufman, 2009; Nelson, Canivez & Watkins, 2013), with well established structural validity across assessments in various samples (Georgas, Weiss, Van de Vijver, & Saklofske, 2003; Nelson et al., 2013; Tulskey, Saklofske, & Zhu, 2003; Watkins & Beaujean, 2014). The clinical applications of the Wechsler assessments have been explored at length in various books written on the appropriate use for assessment and interpretation, and their validity in clinical practice has been consistency demonstrated (Prifitera, Saklofske, & Weiss, 2008; Tulskey, 2003; Weiss, Saklofske, Coalson, & Raiford, 2010; Weiss, Saklofske, Holdnack & Prifitera, 2015).

Further, for over 70 years the Wechsler assessments have gone through immense item content and statistical scrutiny, undergoing extensive revision and norms standardization every 8-10 years. This ensures that the retained subtests include relevant visual stimuli, outdated items are removed, and that new or revised subtests reflect the updated literature on cognitive testing. It also provides users with up-to-date normative information for their country population. For this most recent version of the Wechsler children's scale, the reliability and validity of the assessment was critically examined and is described in detail in the Canadian Technical Manual (Wechsler, 2014b).

#### *1.4.2 Distinct Canadian Norms*

The WISC-V<sup>CDN</sup> also has the advantage of having distinctly Canadian norms. The development of Canadian normative data for American-based intelligence tests began in response to criticisms from Canadian practitioners that felt the American normative information was not adequately representative of the Canadian population's performance (Beal, 1988; Holmes, 1981). Normative discrepancies between the two countries were explored, and results showed that Canadian samples had higher mean scores and smaller variability. This prompted the development of distinctly Canadian norms for all Wechsler assessments, starting with the Wechsler Intelligence Scale for Children third edition (WISC-III; Wechsler, 1996). Consistent with prior findings, the WISC-III showed higher performance levels together with smaller distributions among Canadian children, and differences were greatest in the high and low ranges (i.e., the tails) of the score distribution (Wechsler, 1996). Based on these findings, performance differences in the Wechsler Adult Intelligence Scale third edition (WAIS-III; Wechsler, 1997) were also

investigated. Again, results showed Canadians had higher raw scores but smaller variability than American adults (Wechsler, 2001).

An important consideration for interpreting these analyses is that it was also demonstrated that the test items and structure worked both *consistently* and *equally well* in both countries, confirming that the same cognitive constructs were being assessed across country samples. Given the observed structural validity but consistent score differences, the need for independent Canadian norms was clear (Saklofske, Patterson, Gorsuch, & Tulsy, 2001).

#### *1.4.3 Representing the Current Canadian Population*

The WISC-V is the most recent publication in the WISC family of intelligence assessments, published in late 2014 (Wechsler, 2014b). The temporal relevance of this publication is significant in that it ensures that the demographic context is both applicable and appropriately stratified to the *current* Canadian population. This is unique, as Canadian norms are not always an available option for assessments. The WISC-V<sup>CDN</sup> norms were also developed using a national-scale multiphase standardization procedure. It was developed over many years, and involved the assessment of approximately 1000 children across the country to collect the Canadian norms. Developers collected assessment data from children using the demographic data from the 2011 National Household Survey (NHS; Statistics Canada, 2013) to appropriately stratify the population. This process ensures that no one province or location is inappropriately biasing the normative data, and that the country as a whole is represented in the norms.

Finally, it is the same assessment that was used in the U.S. examination of demographic differences by Weiss et al., making this the ideal test candidate from which to base the current test hypotheses. This, in conjunction with its well-established validity, availability of up-to-date Canadian norms, and breadth of coverage of the Canadian population, it was deemed appropriate for this examination.

### ***1.5 Rationale***

Thus far, extensive research has examined the societal context of the influence of demographic differences on WISC-V performance in the U.S. population. However, there has been little to no evaluation within the Canadian population to understand the potential impact on intelligence test scores in relation to these demographic factors. Given the widespread use of the WISC-V<sup>CDN</sup> across the country in schools and clinics, the results from this research are not only important for use and interpretation of the WISC-V<sup>CDN</sup>, but also from social and education perspectives in Canada.

The current study provides valuable insight and critical information for both the Canadian psychological and education communities. Further, most assessment articles and manuals written on intelligence test interpretation include statements such as: *“When interpreting results, the clinician should consider additional factors such as the client’s educational, medical, cultural, and family history...”*. The climate of assessments in today’s world is such that this advice has been repeated so frequently that it is often taken for granted and overlooked. While most clinicians would agree on the veracity of such a statement, not all implement it consistently, if at all, in actual practice. This contextual

screenshot can offer a valuable framework to understanding children's differential IQ performance and making sense of individual differences.

### ***1.6 Objective***

The purpose of this study is to extend the findings of Weiss et al. who used the WISC-V test to assess the demographic influences on intelligence scores in a U.S. sample. A similar approach will be used here with the Canadian sample who comprised the standardization data for the WISC-V<sup>CDN</sup>. My goal is to examine and discuss how these differences might impact the development and expression of intelligence.

### ***1.7 Hypotheses***

Based on the significant race/ethnicity and socioeconomic status influences that were observed in the Weiss et al. study for the American sample, the following hypotheses are proposed for the examination of the Canadian data:

1. Children will have significant IQ performance differences on the WISC-V<sup>CDN</sup> based on their socioeconomic status (SES). Specifically, those in lower SES groups will have lower mean scores than those in higher SES groups.
2. Given the race/ethnicity differences in IQ scores found in the U.S. studies, differences in race/ethnicity in the Canadian sample will be examined to establish if and where any significant differences exist.
3. Based on the findings observed in the U.S. study, there will be a significant interaction effect, such that ethnicity will influence IQ scores in the lower SES

groups (PED 1 and 2), but not significantly influence this relationship in the higher SES groups (PED 3 and 4).

4. Examining the predictive influence of ethnicity, PED level, and income on FSIQ scores, the influence of ethnicity on FSIQ performance will be significant, yet small compared to the influence that the SES variables have on FSIQ.
5. There will be a significant mediation effect, demonstrating that SES will partially mediate the effect that ethnicity has on IQ performance.



## CHAPTER 2: METHOD

### 2. Method

#### 2.1 Participants

The participants in this study comprised the final WISC-V<sup>CDN</sup> normative sample. This is a nationally representative sample of 880 English-speaking Canadian children ages 6-16 years. The sample targets were based on the 2011 National Household Survey (NHS) available from Statistics Canada. The sample was stratified across the following five variables; *age*, *sex*, *race/ethnicity*, *parent education level*, and *geographic region*. The following presents the characteristics of the sample:

**Age:** Participants were divided into 11 age groups, from 6 – 16 years. There were 80 participants in each age group.

**Sex:** Equal number of female and male children were recruited for each age group.

**Ethnicity:** For each age group, the proportions of Asian, Caucasian, First Nations, and Other racial/ethnic groups were based on the racial/ethnic proportions of children within the corresponding age group of the Canadian population. Overall, the sample was 10% Asian, 74% Caucasian, 7% First Nations, and 9% Other.

**Parent Education Level:** The normative sample was stratified by four parent education levels which were based on the total average number of years of school completed by the parent(s). If the child resided with only one parent or guardian, the educational level of that parent or guardian was used. If the child resided with

both parents or with two guardians, the average of both individuals' educational levels was used, with levels rounded up to the next highest level. The four parent education levels were defined as listed in Table 1 below.

Table 1.

*Parent Education Level (PED) Categorization and Percentage in Sample*

<b>PED Level</b>	<b>Definition</b>	<b>% in Sample</b>
PED 1	≤11 years of education completed (no/some high school completed, but no high school diploma)	6%
PED 2	12 years of education completed (high school diploma/equivalent; some college without diploma)	21%
PED 3	13–15 years of education completed (college diploma or trade school certificate)	43%
PED 4	≥16 years of education completed (undergraduate, graduate, and postgraduate degrees)	31%

**Geographic Region:** There are three major geographic regions assigned. *Central* (Ontario and English-speaking regions of Quebec), *East* (Prince Edward Island, Nova Scotia, New Brunswick, and Newfoundland and Labrador), and *West* (Manitoba, Saskatchewan, Alberta, British Columbia, and the Northern Territories). Central Canada comprised 58% of the sample ( $n=508$ ), while the East represented 19% ( $n=99$ ) and the West represented 31% of the sample ( $n=273$ ).

A full summary of the demographic characteristics of the normative sample can be found in Appendix A. Detailed data presenting the comparison of the composition of the final normative sample and the 2011 Canadian NHS data are available in the WISC-V Canadian Technical Manual (Wechsler, 2014b). Overall, there was extremely close alignment of the demographic characteristics of the normative sample with the Canadian

population census data across all stratification variables. Importantly, collapsed across age and region, all race/ethnicity groups targets were met apart from the “Other” group, which fell only 1% below the target. Appropriate ethnicity representation was a central research goal in this data collection, given past criticism of Canadian Wechsler assessments lacking adequate minority inclusion. Further, parent education level target groups were met for both PED 2 and PED 4 groups, and fell less than 2% under target for the PED 1 and PED 3 groups.

### *2.1.1. Inclusion of Children from Various Disability Classifications in the Sample*

To ensure the population was appropriately reflected in the Canadian norms, a proportion of children from various disability classifications were also included in the normative sample. Overall, these cases were *not* specifically recruited, but rather naturally occurred within the sample of cases that were collected. The final WISC-V<sup>CDN</sup> normative data includes approximately 7.8% of children with at least one of the disability classifications outlined in Table 2. For comparison, the disability percentages for the Canadian population of children aged 5 to 14 years in 2006 (Statistics Canada, 2006) are also shown. This was the only *national-level* data available, however, it was collected through a *voluntary* survey; results suggest that 27.2% of Canadian children have at least one of the disability classifications. An alternative source, Human Resources and Skills Development Canada (2001), suggests that in 2006 Canadian children aged 5 to 14 had a disability rate of 4.6%. However, this is not parsed out by individual classification.

Therefore, the limited data that is available suggests the prevalence rates are between 4.6% - 27.2%, but not do provide clear estimates per each diagnosis. Given this

range, the inclusion of only 7.8% of cases in the normative sample may seem under representative. However, this is not a concern for this current study, as these disability groups are not classifications that are associated with IQ functioning deficits. The only group that would be of concern is the developmental group, which have cognitive deficits associated with diagnosis. These data show 2.8% of Canadian children present with a developmental disorder, and the normative study includes a close 2.3%.

Table 2.

*Percentages of the Normative Sample and Canadian Population by Disability Type Classification*

<b>Disability</b>	<b>Definition</b>	<b>Normative Sample</b>	<b>Canadian Population</b>
Age & Mobility	Motor/coordination/movement disabilities or disorders	0.3	3.1
Chronic Condition	The presence of one or more chronic health condition that lasted longer than 6 months and diagnosed by a health care professional	0.6	6.0
Communication	Difficulty speaking or being understood	0.1	4.1
Emotional	Emotional, psychological, or behavioural conditions	0.9	3.1
Hearing	Difficulty hearing	0.0	1.0
Learning	Difficulty learning because of a condition such as attention problems, hyperactivity, or dyslexia	3.4	6.3
Seeing	Difficulty seeing ordinary print or clearly seeing faces from 12 feet	0.2	0.8
Developmental	Cognitive limitations including Down syndrome, autism, intellectual disability	2.3	2.8

*Note.* Table recreated from the WISC-V Canadian Technical Manual. Population data adapted from *Disability in Canada: A 2006 Profile* (p. 10) by Human Resources and Skills Development Canada, 2011, Gatineau, Quebec: Author. Copyright by Her Majesty the Queen in Right of Canada. The Canadian population totals are the sum of the percentages of boys and girls, aged 5–14, with that disability type.

### *2.1.2. Inclusion of Children from Special Education Classifications in the Sample*

In addition to these various disability classifications in the normative sample, specific special education groups, which *do* have associated IQ implications were also included (i.e., **Intellectual Disability** and **Gifted**). Unlike the previous groups, these two samples were specifically recruited for inclusion in the sample so that higher and lower IQ groups would be adequately represented in the normative sample.

To meet eligibility criteria for inclusion in the intellectual disability category, the child must have had a full scale score 2–4 SDs below the mean on a standardized, individually administered measure of cognitive ability (e.g., IQ = 40–70) or have had a current diagnosis of intellectual disability according to The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM–V; American Psychiatric Association, 2013) criteria, or previously met The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM–IV–TR; American Psychiatric Association, 2000) criteria for a diagnosis of intellectual disability, mild or moderate severity. The data outlining prevalence rates of intellectual disability in school-aged children are varied. A 2006 national survey shows the prevalence of developmental disorder or disability among children aged 5–14 years to be at 2.8% (Human Resources and Skills Development Canada, 2011), while a meta-analysis of population-based studies conducted between 1980 and 2009 illustrates the prevalence rate in Canada to be between 0.6%–1.2% (Maulik, Mascarenhas, Mathers, Dua, & Saxena, 2011). Included in this normative sample are 1.7% of children who had a confirmed intellectual disability.

In addition, children who met the criteria for intellectual giftedness were also included in the sample. Based on the number of children enrolled in gifted programs across Canada, as identified by provincial education websites, approximately 2-5% of the Canadian school-aged population is identified as gifted. To be included they must have had a full-scale score  $\geq 2$  SDs above the mean on a standardized, individually administered measure of cognitive ability (e.g.,  $IQ \geq 130$ ) and receiving services for intellectual giftedness in school. The normative sample contains 2.8% of gifted children.

## **2.2 Measures**

### *2.2.1 Wechsler Intelligence Scale for Children: Canadian – Fifth Edition (WISC-V<sup>CDN</sup>).*

The WISC-V<sup>CDN</sup> is an individually administered, norm-referenced intelligence assessment that allows for a comprehensive diagnostic profile of a child or adolescent's cognitive strengths and weaknesses. The test can be used with children and adolescents ranging from 6 years, 0 months to 16 years, 11 months of age. The theoretical framework of the WISC- V<sup>CDN</sup> reflects structural intelligence theories, for example, the Cattell-Horn-Carroll (CHC) theory of intelligence, and is based on factor analytic results employing a hierarchical model of general intelligence at the top, with various related abilities at the level beneath (Wechsler, 2014). The framework allows for four levels of interpretation: *Full Scale*, *Primary Index*, *Ancillary Index*, and *Complementary Index*, with each level composed of one or more scales. Each scale is made up of a combination of subtests used to attain information for the composite score. The WISC- V<sup>CDN</sup> allows for a Full Scale IQ score, and is further broken down into five primary domains (primary index scores): *Verbal Comprehension*, *Visual Spatial*, *Fluid Reasoning*, *Working Memory*, and

*Processing Speed*. The assessment allows further breakdown of abilities through its Ancillary Index scores, including: *Quantitative Reasoning*, *Auditory Working Memory*, *Nonverbal*, *General Ability*, and *Cognitive Proficiency*. Finally, three scales make up the Complementary Index scale level: *Naming Speed*, *Symbol Translation*, and *Storage and Retrieval*. Only the Full Scale IQ data (comprised of the five primary index domains) will be used for the analyses in this study. Appendix B illustrates the full test framework, listing all subtests and those required to attain each of these listed indices.

### 2.2.2. *Home Environment Questionnaire*.

The Home Environment Questionnaire (HEQ) was developed by the research team to capture important information regarding each child's daily academic and non-academic activities, language skills, and environment history. Questions range from basic demographic information (e.g., age, primary language) to questions regarding daily activities (e.g., homework habits and extracurricular activities). Information is also collected on the experiences of caregivers, household income, and place of residence. A copy of the HEQ is found in Appendix C.

## 2.3 *Study Variables*

2.3.1 *Full Scale IQ*. Full Scale IQ is derived using seven core subtests: *Similarities*, *Vocabulary*, *Block Design*, *Figure Weights*, *Matrix Reasoning*, *Digit Span*, and *Coding*. This creates a 2-1-2-1-1 subtest format from the primary indices: Verbal Comprehension, Visual Spatial, Fluid Reasoning, Working Memory, and Processing Speed.

*2.3.2 Parent Education Level (PED).* While there are variations in the way that SES is operationalized, it is broadly defined as the combined total of an individual's or family's economic position based on three indicators: income, education, and occupation. In the present study, Parent Education Level (PED) is used as the measure of SES. This was used as the stratification variable for SES in the standardization sample, and was chosen to be used in the current study as well. This is supported by the findings that most authors chose parent education as the single indicator of SES when developing assessments for children because parent education level shows a high correlation to *overall* SES and to the other direct indicators of SES (parent occupation and income). Further, parent education level is more reliably reported/disclosed than household income (Weiss et al.).

*2.3.3. Combined Annual Income.* As previously mentioned, while PED level is the primary indicator of SES, household income was also collected, and therefore used as an supplementary SES variable in the regression analyses. This was reported by parents on the HEQ, and they were asked to selected one of 12 categories: 1 = < \$9,999, 2 = \$10,000–\$14,999, 3 = \$15,000–\$19,999, 4 = \$20,000–\$29,999, 5 = \$30,000–\$39,999, 6 = \$40,000–\$49,999, 7 = \$50,000–\$59,999, 8 = \$60,000–\$69,999, 9 = \$70,000–\$79,999, 10 = \$80,000–\$99,999, 11 = \$100,000–\$199,999, 12 = >\$200,000.

*2.3.4 Ethnicity.* Parents of participants reported their child's ethnicity by indicating a category on the Consent Form. There were four categories that could be selected from: Asian, Caucasian, First Nations, or Other. The Asian category included the following subcategories: [Chinese, Japanese, Korean], Southeast Asian [Cambodian, Indonesian,



Laotian, Vietnamese], and South Asian (East Indian, Pakistani, Sri Lankan, and Filipino). If more than one ethnicity was selected, the child was categorized in the Other group.

For those who identified as First Nations, data were also collected to determine whether the child lived on or off reserve. Per the 2006 report (Statistics Canada, 2006), approximately 46% of children under the age of 14 years lived on reserve while 54% lived off reserve. These numbers are similar to those in the 2011 NHS report, stating that of the First Nations people with registered status, approximately one half (49%) live on a reserve or settlement (Statistics Canada, 2011). Of the First Nations sample included in this study, 42% of children lived on reserve and 58% either lived off reserve or did not specify (46% off reserve, 12% not specified).

## ***2.4 Procedure***

### *2.4.1 Developing the Study Matrix*

To compose the study targets for data collection, the 2011 National Household Survey (NHS) was used. Traditionally in the development of Canadian norms, statistics directly from the Canadian census are used to derive standardization targets. However, the 2011 census did not make the disclosure of some key demographic variables mandatory that were required for stratification (i.e. race/ethnicity and parent education level), as was done in previous census forms. Therefore, the voluntary NHS was used instead because it included most of the questions previously found on the mandatory long-form Canadian census, and at the time was the only national population data available for estimating the racial/ethnic and educational level composition of the Canadian population, by age and sex. Given the voluntary nature of the NHS compared to

the mandatory census forms used in the past, this raises concerns over the reliability of the data being used for stratification. Therefore, to ensure accurate sampling targets two sets of targets were created for comparative purposes; the first using the 2006 mandatory census data, and the second using the 2011 NHS. The examination revealed that the overall population trends were consistent between the target samples, and in the expected direction of trends observed in earlier population of census data. This step was essential given the importance of using accurate population demographics for the development of the Canadian norms, and therefore given its established reliability, the more recent 2011 NHS was preferred over the 2006 census data in compiling the sampling targets.

#### *2.4.2 Examiners*

The WISC-V<sup>CDN</sup> assessment data was collected by trained examiners from across Canada. Overall, a total of 92 examiners were enrolled as examiners for this study. All examiners had previous testing experience with a Wechsler assessment, and were actively involved with clinical practice, psychological research, and/or assessment training. All examiners had to qualify to be eligible to participate as an examiner in the study. To do so, they first completed an administration test. This test was completed by potential examiners after being given an allotted time to review the new testing materials, and ask the research team questions. The research team then reviewed the results and provided corrective feedback for any administration errors or incorrect scoring. Next, examiners completed a review case. The review case was each examiner's first test administration of a child enrolled in the standardization study. Detailed and specific corrective feedback was provided on the review case to the examiner, focusing primarily on any administrative errors which would result in loss of data. If deemed appropriate, the

examiner was accepted to continue their participation in the study. All future cases were also screened for accuracy in administration, and examiners were contacted regarding any irregularities in the case protocols. Examiners were reimbursed with a research honorarium for each test administration

#### *2.4.3 Enrolment and Collection*

All data was collected as a part of the 2014 Canadian Standardization study. The study began in June 2013 and continued through August 2014. Participating examiners submitted potential candidates for testing via an online reservation system, listing key demographic information so that the child could be assessed for eligibility. A detailed list of the eligibility criteria for the inclusion in the study is presented in Appendix D. If accepted, the examiner was notified and given a two-week timeline to complete the assessment and mail in the test protocol. To account for varying participant and examiner availability and schedules, in some instances protocols could be administered past the two-week timeline, however this was only allowed if the examiner asked permission and if the child did not age-out of their assigned age group during that time. Participants were also recruited via web-based community postings, and were assigned to an examiner in their area if eligibility criteria were met and if they were needed in the study matrix. Upon completion, all test cases were mailed directly into the research office for screening of accuracy, protocol scoring, and data entry. All participants were paid a research honorarium for their participation in the study via VISA gift card.

#### *2.4.4 Administration*

All WISC-V<sup>CDN</sup> test protocols were completed via paper-and-pencil format. Parents completed the Home Environment Questionnaire, again in paper format, while the child completed the WISC-V<sup>CDN</sup> assessment. All assessments took place in an agreed upon location by the examiner and the child's parent. The specification was that it was to be a quiet, comfortable location where the child would not be distracted or interrupted. Most often, this was the examiner's office, child's home, or local community (e.g., library). The protocol demanded strict adherence to the standardized administration format, and examiners were required to note any changes made to this due to extenuating circumstances. Subtest start and stop times were recorded on the protocol to help the research team verify that appropriate order was maintained for subtest administration.

#### *2.4.5 Special Group Eligibility*

The DSM-IV-TR (American Psychiatric Association, 2000) was used for most of the data collection process as the standard for classification. To be eligible for special group studies, children were required to have had a pre-existing diagnosis. Therefore, the DSM-IV-TR guidelines were most appropriate given that prior diagnoses would have been based on these criteria. There were a few instances however where a diagnosis was very recent (i.e., for intellectual disability) and therefore a DSM-5 categorization was accepted in these cases. A detailed account of the eligibility criteria for the special group studies is presented in Appendix E.

#### *2.4.6 Sample Accuracy*

Various measures were taken to ensure the adherence to the stratification matrix, as well as accuracy of the collected data. From the onset, extremely narrow margins were set for the sample targets using the population statistics ensure the demographic composition aligned with the Canadian population. These targets were followed in the recruitment as well as the acceptance of submitted cases. Second, follow-up phone calls to the participating families were completed for a minimum of one case per examiner to ensure the collected demographic information was correct and that the child was appropriately categorized in the sampling matrix. Finally, in addition to the extensive enrolment and training processes for examiners, strict adherence to the administration rules were monitored by the research team, and examiners were contacted regarding any inconsistencies throughout the study.

#### *2.4.7 Scoring and Data Entry*

All data collected by the examiners were scored by trained research team members. Given the subjectivity of the verbal subtests, each scorer was evaluated on their ability to give appropriate score codes on verbal responses. Each test case was double-scored independently by two qualified scorers. The separate results were entered into a database and any entries with discrepancies were resolved by a third scorer (the resolver). Inter-scorer agreement was assessed, and overall was high, ranging from .98 to .99.

## ***2.5 Data Analytic Strategy***

First, two separate one-way ANOVAs will be conducted. The first will examine whether there are FSIQ performance differences based on the SES of the child. The sample will be grouped into four separate groups based on parent education level (used as a single indicator for SES) and mean FSIQ score differences will be examined. The second one-way ANOVA will test the hypothesis that FSIQ scores may differ based on the child's ethnicity. The sample will be grouped into four groups (Asian, Caucasian, First Nations, and Other) based on their reported ethnicity, and mean differences will be compared. While these analyses are based on the U.S. findings, given the lack of previous examination in Canadian data, the choice was made to keep these analyses open ended, rather than in one direction; despite the pre-existing knowledge from U.S. studies that might have alternatively influenced a 1-tailed directional hypothesis.

Then, a two-way ANOVA will be conducted to test the hypothesis that there will be a significant interaction effect between the two variables (PED and ethnicity) and their influence on the outcome variable of FSIQ.

Next, to understand the predictive role of the demographic variables on FSIQ scores, a standard linear regression analysis will be conducted to test the hypothesis that ethnicity, PED level, and income significantly predict FSIQ performance. Given the nature of the ethnicity variable, this independent variable will be dummy-coded to allow group comparisons to be made.

Finally, a statistical mediation analysis will be conducted to test the hypothesis that SES mediates the relationship between race/ethnicity and FSIQ performance. Given

the multi-categorical nature of the independent variable (four race/ethnicity groups), rather than the traditional dichotomous or continuous variable used in mediation analysis, the data will be analyzed using the approach outlined by Hayes & Preacher (2014).

## CHAPTER 3: RESULTS

### 3. Results

#### 3.1 Data Screening

Analysis of missing data indicated that for the variables *FSIQ*, *Parent Education Level*, and *Ethnicity*, there were no missing data. Given that this was the finalized standardization data set, all cases had a generated Full-Scale IQ score (FSIQ). For the final variable utilized in the regression and path analyses (*Income*) there was approximately 20% (175) missing data points. This was not unexpected given this was not a required study variable and that individuals are generally more hesitant to report this information on questionnaires. Given this proportion of missing cases for income, this variable was only used as a *secondary measure* of SES in the regression models.

Using IBM SPSS Statistics, Version 21 (IBM Corp, 2012) standard data screening procedures were implemented. To assess multivariate normality, both skewness and kurtosis were evaluated for the demographic variables, as well as for FSIQ and the primary index scores that comprise the FSIQ score. This was conducted using the skew index (SI) and the kurtosis index (KI). Variables with  $SI > |3.0|$  are considered highly skewed (Curran, West, & Finch, 1997; Kline, 2016) and variables with  $KI > 10.0$  suggest there are instances of kurtosis (Kline, 2016). The highest skewness value of the sample was -.508, and the highest kurtosis value of the sample was -1.198, therefore no instances of abnormal or extreme skewness or kurtosis was detected.



### 3.2 Analyses

All analyses were conducted using IBM SPSS Statistics, Version 21 (IBM Corp, 2012), apart from the final analysis (mediation analysis) which was conducted using the Mplus Version 7.4 software (Muthén & Muthén, 1998-2015).

#### 3.2.1 Parent Education Level and FSIQ

A one-way between-subjects ANOVA was conducted to compare the mean FSIQ on the WISC-V<sup>CDN</sup> for children based on the four PED groups. This analysis was done test the hypothesis that there would be significant mean FSIQ performance differences based on the child's SES, such that children in the lower PED level groups would have significantly lower mean FSIQ scores. Table 3 provides a description of the groups, including the PED level description, sample size, mean, and standard deviation (*SD*). Prior to the analysis, the Levene test of homogeneity of variance was used to examine whether there were any serious violations of the homogeneity of variance assumption across groups, but no significant violation was found:  $F(3,876) = .197, p = .898$

Table 3.

*Mean FSIQ of Children by Parent Education Level*

Parent Education Level	Mean FSIQ ( <i>SD</i> )	<i>n</i>
<b>PED 1:</b> No high school or some high school, but no high school diploma	92.53 (13.89)	51
<b>PED 2:</b> High school diploma or equivalent; some college without diploma	93.73 (14.66)	183
<b>PED 3:</b> College diploma or trade school certificate	98.84 (13.69)	375
<b>PED 4:</b> Undergraduate, graduate, and postgraduate degrees	107.24 (13.71)	271

The overall  $F$  for the *one*-way ANOVA was statistically significant,  $F(3,876) = 42.58, p < .001$ . This corresponded to an effect size of  $\eta^2 = .13$ , and this effect was found with an observed power of 1.00. All possible pairwise comparisons were carried out using the Tukey HSD test. Based on this test (using  $\alpha = .05$ ), it was found that the PED 1 group scored significantly *lower* on FSIQ than the PED 3 ( $p \leq .05$ ) and PED 4 ( $p < .001$ ) groups. The PED 2 group also scored significantly *lower* on FSIQ than the PED 3 ( $p < .001$ ) and PED 4 ( $p < .001$ ) groups. The PED 3 group scored significantly *higher* on FSIQ than PED 1 ( $p \leq .05$ ) and PED 2 ( $p < .001$ ) groups, and significantly *lower* than the PED 4 ( $p < .001$ ) group. Finally, the PED 4 group scored significantly *higher* on FSIQ than PED 1, PED 2, and PED 3 groups ( $p < .001$ ). There were no significant differences observed between PED 1 and PED 2 ( $p = .948$ ). Figure 1 shows a 95% confidence interval (CI) around each group mean.

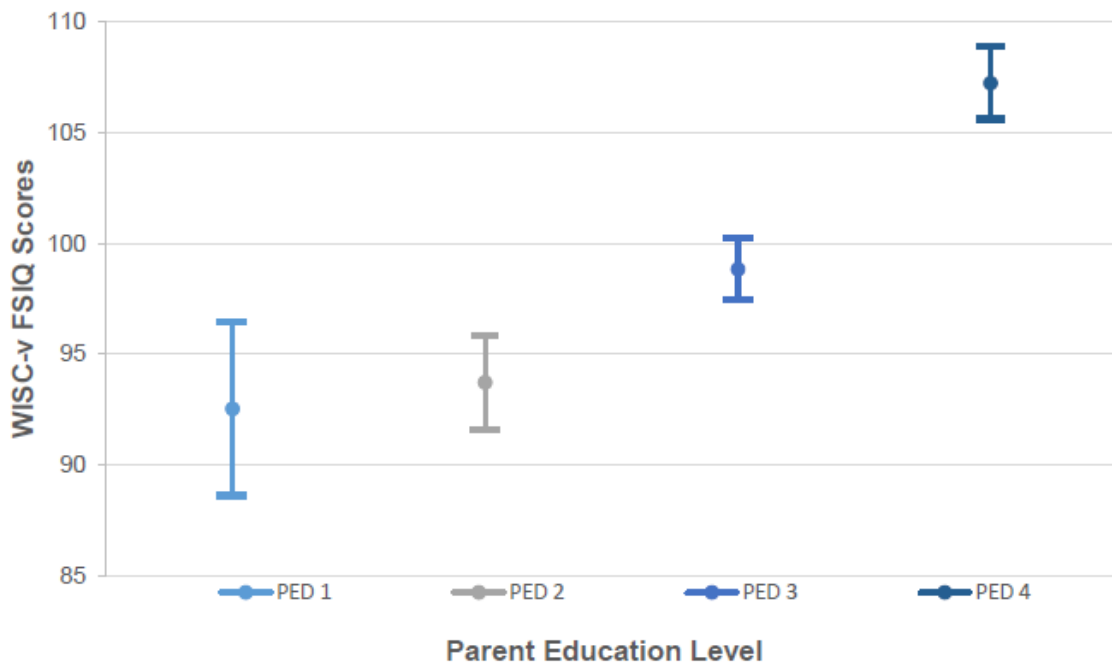


Figure 1. Mean FSIQ scores with 95% CI for each PED level group

### 3.2.2 Ethnicity and FSIQ

A one-way between-subjects ANOVA was done to compare the mean FSIQ scores on the WISC-V<sup>CDN</sup> between the four ethnicity groups. This analysis was conducted to test the hypothesis that there would be significant mean FSIQ performance differences based on the child's ethnicity. Children were grouped by self-reported ethnicity into one of four groups. Table 4 provides a description of the groups, including the ethnicity classification, sample size, mean, and standard deviation (*SD*). Prior to the analysis, the Levene test of homogeneity of variance was used to examine whether there were any serious violations of the homogeneity of variance assumption across groups. This test revealed no significant violation:  $F(3,876) = .868, p = .457$ .

Table 4.

*Mean FSIQ of Children by Ethnicity*

<b>Ethnicity</b>	<b>Mean FSIQ (<i>SD</i>)</b>	<b><i>n</i></b>
<b>Asian</b>	102.29 ( <i>SD</i> =15.36)	96
<b>Caucasian</b>	100.59 ( <i>SD</i> =14.82)	647
<b>First Nations</b>	95.07 ( <i>SD</i> =14.61)	60
<b>Other</b>	95.99 ( <i>SD</i> =13.59)	77

The overall *F* for the *one*-way ANOVA was statistically significant,  $F(3,876) = 5.25, p = .001$ . The effect size was  $\eta^2 = .02$ , and was found with an observed power of .93. All possible pairwise comparisons were carried out using the Tukey HSD test. Based on this test (using  $\alpha = .05$ ), it was found that both the Asian and Caucasian groups scored significantly higher on FSIQ compared to the First Nations and Other groups ( $p \leq .05$ ).

There were no observed significant differences between the Asian and Caucasian groups ( $p = .718$ ) or the First Nations and Other groups ( $p = .984$ ). Figure 2 shows a 95% confidence interval (CI) around each group mean.

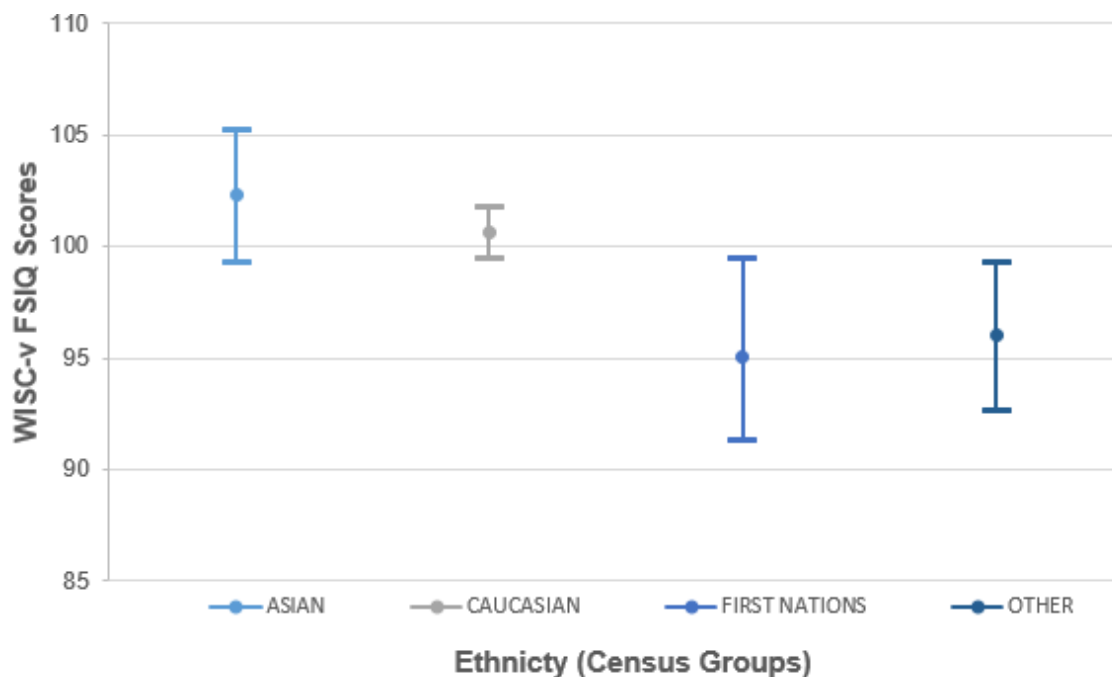


Figure 2. Mean FSIQ with 95% CI for each ethnicity group

### 3.2.3 Examining the Interaction between Ethnicity and Parent Education

A two-way ANOVA was conducted to test the interaction between ethnicity and SES (using PED) on the effect of FSIQ performance. This was conducted to test the hypothesis there would be a significant interaction effect, such that ethnicity will influence IQ scores in the lower SES groups but not significantly influence the higher SES groups. Table 5 presents the means, *SD*, and sample sizes for each group. There was no statistically significant interaction observed,  $F(9,864) = .587, p = .808$ . Figure 3 presents the plot of this two-way ANOVA.

Table 5.

*Children's Mean FSIQ by Ethnicity and Parent Education Level*

<b>Parent Education Level</b>	<b>Ethnicity</b>	<b>Mean FSIQ (SD)</b>	<b>N</b>
<b>PED 1</b>	Asian	97.29 (SD=3.71)	14
	Caucasian	94.09 (SD=2.90)	23
	First Nations	86.50 (SD=4.91)	8
	Other	83.50 (SD=5.67)	6
<b>PED 2</b>	Asian	98.60 (SD=4.39)	10
	Caucasian	94.43 (SD=1.23)	127
	First Nations	92.27 (SD=2.72)	26
	Other	88.70 (SD=3.10)	20
<b>PED 3</b>	Asian	97.43 (SD=2.53)	30
	Caucasian	99.12 (SD=.791)	308
	First Nations	97.89 (SD=3.27)	18
	Other	97.42 (SD=3.19)	19
<b>PED 4</b>	Asian	108.31 (SD=2.14)	42
	Caucasian	107.92 (SD=1.01)	189
	First Nations	106.38 (SD=4.91)	8
	Other	102.03 (SD=2.45)	32

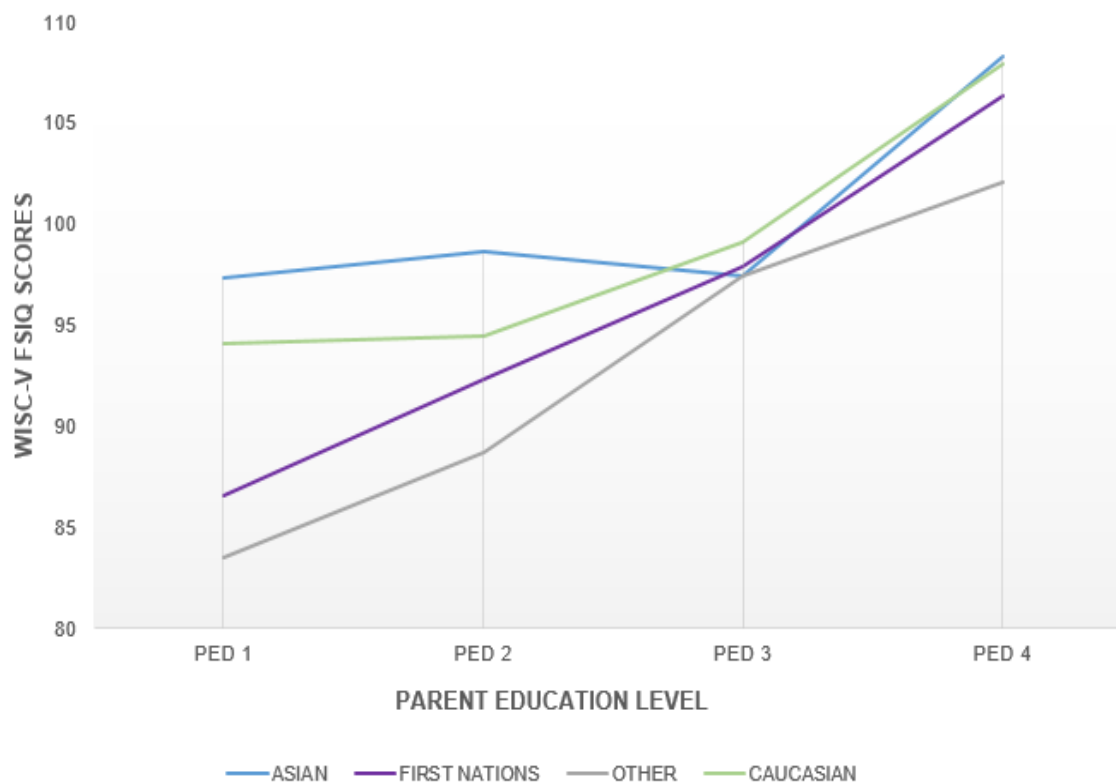


Figure 3. Children's FSIQ Scores by Parent Education Level and Ethnicity

This interaction was not significant, which did not support the initial hypothesis. However, an examination of power suggested that the power to detect this interaction was .293, approximately 30%, which is well below the minimum suggested value of 80%. Therefore, further inspection of the data suggested that this was likely a result of the unbalanced sample sizes and in some cases, very small  $n$  counts when broken down into each PED x ETHNICITY group. Therefore, there was not sufficient power to detect this interaction. Examining the plotted means, there are visible differences in the PED 1 group between the highest and lowest ethnicity group means, spanning almost a full standard deviation (13.73). Therefore, while not initially planned, a post-hoc analysis was conducted to test this relationship *specifically* within the PED 1 group. An ANOVA was conducted after splitting the data set by the PED variable. This revealed still a non-

significant result,  $F(3, 47) = 2.125, p = .110$ , again likely because of unbalanced cells. However, the  $\eta^2 = .119$ , and the power to detect this result was .508. This finding provides evidence to suggest that there is indeed a strong effect here, however given the sampling cell  $n$  counts, there is not sufficient power to detect it.

### 3.2.4 Ethnicity, Parent Education, and Income as Predictors of FSIQ

To test the hypothesis that *Ethnicity, PED level and Income* significantly predict FSIQ, a linear regression was performed. Due to missing responses in the income variable, only  $n=705$  participants were included in this analyses, as a listwise deletion was employed. To begin, the ethnicity variable was dummy-coded to allow comparison of this relationship between all four ethnicity groups at one time. The “*Other*” category was used as the reference group. Comparing all ethnicity groups at one time was a deviation from the approach taken by Weiss et al. In their evaluation, two distinct ethnicity groups were compared one at a time; this comparison was warranted given the previous findings of specific between-race differences. However, given the lack of previous examination of Canadian data in this manner, there was not sufficient evidence to guide any two ethnicity groups to be compared independently, and therefore statistical modelling techniques were employed to allow all groups to be compared at once.

The three variables were then added in three different stages. The first, where ethnicity was regressed on FSIQ, showed a significant result  $F(3, 701) = 5.307, p = .001$ ;  $R^2 = .022$ . This finding suggests that FSIQ can be predicted from ethnicity, and that it accounts for 2.2% of the variance, corresponding to a small - medium effect. This effect was previously determined in the one-way ANOVA conducted on ethnicity, where the  $\eta^2$

= .02. However, ethnicity was also included in this regression model to allow us to see the unique influence accounted for by the SES variables. The second stage added PED to the model. This was again statistically significant,  $F(4,700) = 23.54, p < .001; R^2 = .119$ , and  $\Delta R^2 = .096$ . This shows that adding PED level to the model accounted for an additional 9.6% of the variance in predicting FSIQ, a very large effect. Finally, income was added to the model. Again, there was a significant result,  $F(5, 699) = 21.37, p < .001; R^2 = .133$ , and  $\Delta R^2 = .014$ . Therefore, income added another 1.4% predictive effect. Consistent with the hypotheses, ethnicity, PED level, and income all significantly predicted FSIQ in the sample, accounting for large proportion of the variance (13.3%) predicting FSIQ scores. Further, while the influence of ethnicity was significant, it was smaller compared to the influence of parent education and income.

Table 6.

*Summary of standard regression analysis to predict FSIQ from Ethnicity, Parent Education, and Income*

		$\Delta R^2$	<i>b</i>	<i>SE</i> <sup>b</sup>	$\beta$	<i>t</i>	Sig.
<b>Model 1</b>	Constant	<b>.022</b>	96.58	2.05		47.05	<b>.000</b>
	Dummy 1		8.14	2.73	.16	2.99	<b>.003</b>
	Dummy 2		4.96	2.15	.14	2.31	<b>.021</b>
	Dummy 3		-1.315	3.07	-.02	-.44	.669
<b>Model 2</b>	Constant	<b>.096</b>	80.08	2.71		29.51	<b>.000</b>
	Dummy 1		6.73	2.60	.13	2.45	<b>.014</b>
	Dummy 2		4.44	2.04	.13	2.18	<b>.030</b>
	Dummy 3		1.52	2.94	.02	.52	.604
	PED		5.57	.64	.32	8.75	<b>.000</b>
<b>Model 3</b>	Constant	<b>.014</b>	78.55	2.73		28.76	<b>.000</b>
	Dummy 1		6.68	2.58	.13	2.59	<b>.010</b>
	Dummy 2		3.26	2.06	.09	1.59	.113
	Dummy 3		.45	2.93	.01	.15	.879
	PED		4.44	.72	.25	6.21	<b>.000</b>
	Income		.692	.21	.14	3.36	<b>.001</b>

*Note.* Dummy1: Asian =1; Dummy 2: Caucasian = 1; Dummy3: First Nations = 1. PED = Parent Education Level. Bolded values are significant at  $p < .05$ .  $n=705$ .

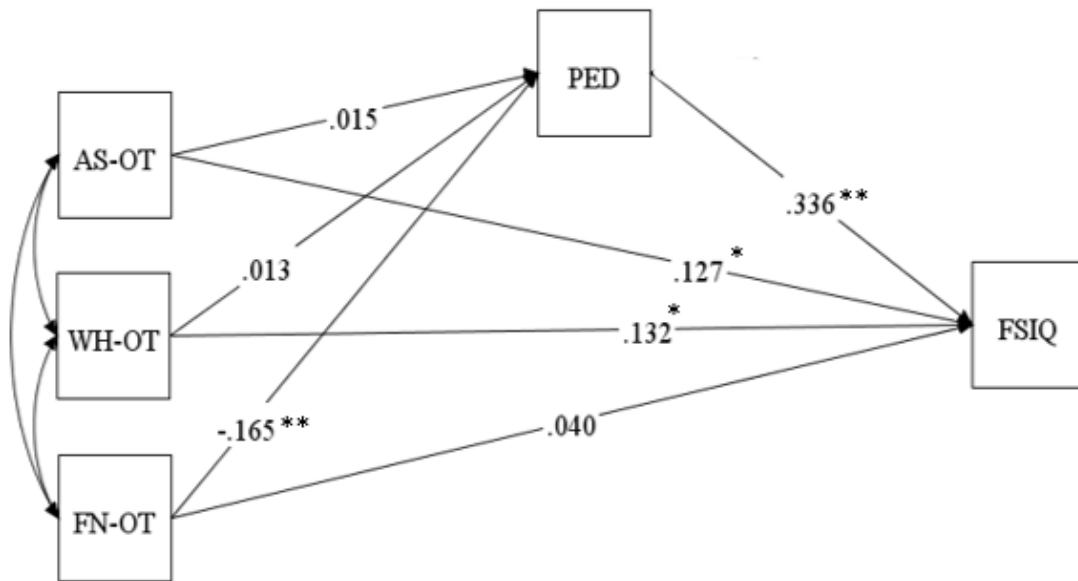


### 3.2.5 *SES as a mediator in the relationship between ethnicity and FSIQ*

As demonstrated by the previous analysis, SES overall (especially PED) plays a significant role in the prediction of FSIQ. To further examine this relation, a path analysis was performed to test the hypothesis that SES would partially mediate the relationship that exists between ethnicity and FSIQ. In traditional mediation analysis, the independent variable is either a dichotomous categorical or continuous variable. In this study, this is not the case; the ethnicity variable has four distinct, non-ordinal groups. Therefore, to avoid resorting to aggregating groups or discarding specific data for these analyses, the approach for using a multicategorical independent variable in mediation analysis, as described by Hayes and Preacher (2014), was applied. The first step involves dummy coding the variable; therefore, the ethnicity variable was dummy coded to allow comparison between all four groups at one time and the “Other” category served as the reference group. Next, a mediation analysis was conducted with using Mplus Version 7.4 (Muthén & Muthén, 1998-2015) using a maximum likelihood estimation procedure, to examine the direct, indirect, and total effects of the model. Like the modelling approach used by Weiss et al., three separate paths were modelled: 1) the relation between ethnicity and FSIQ with only *PED* as a mediator, 2) the relation between ethnicity and FSIQ with only *Income* as a mediator, and finally 3) the relation between ethnicity and FSIQ with *both PED and Income* as mediators. The analyses were conducted using 95% and 99% bias corrected bootstrap confidence intervals for relative indirect effects.

### 3.2.5.1 PED as Mediator

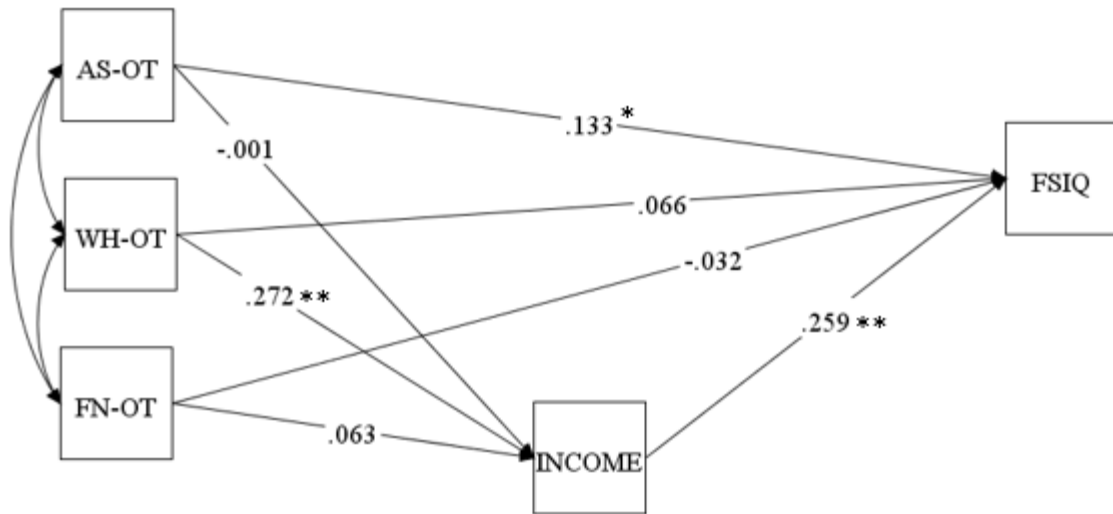
The first path analysis modelled the relation between ethnicity and FSIQ with parent education as the mediator. This path with standardized coefficients is shown in Figure 4. Significant direct effects between ethnicity and FSIQ were observed between all ethnicity groups, apart from the FN-OT group. The specific indirect effects for the AS-OT and WH-OT groups were non-significant. The specific indirect effect of FN-OT group however was significant,  $b = -.055$ ,  $p = .001$ . This was confirmed as the bias-corrected bootstrap confidence interval did not include zero. This suggests that PED level significantly mediated the relationship between ethnicity and FSIQ for the difference between the First Nations and Other group, however, did not for the other two ethnicity comparison groups. This partially supports the initial hypothesis. An interesting finding is that the total effects for all pathways were significant, except for the FN-OT pathway. This lack of *significant total effect* alongside a *significant indirect effect* suggests the presence of inconsistent mediation, whereby the opposing directional signs of the two pieces of the indirect effect are cancelling each other out.



**Figure 4.** Path diagram of parent education level as a mediator in the relation between ethnicity and FSIQ. All reported values are standardized coefficients. \*\* $p < .001$ , \* $p < .05$ . **Specific indirect effects include** AS-OT:  $b = .005$ ,  $p = .794$ ; WH-OT:  $b = .004$ ,  $p = .834$ ; FN-OT:  $b = -.055$ ,  $p = .001$ . **Total effects include** AS-OT:  $b = .177$ ,  $p = .004$ ; WH-OT:  $b = .136$ ,  $p = .006$ ; FN-OT:  $b = -.015$ ,  $p = .703$

### 3.2.5.2 Income as Mediator

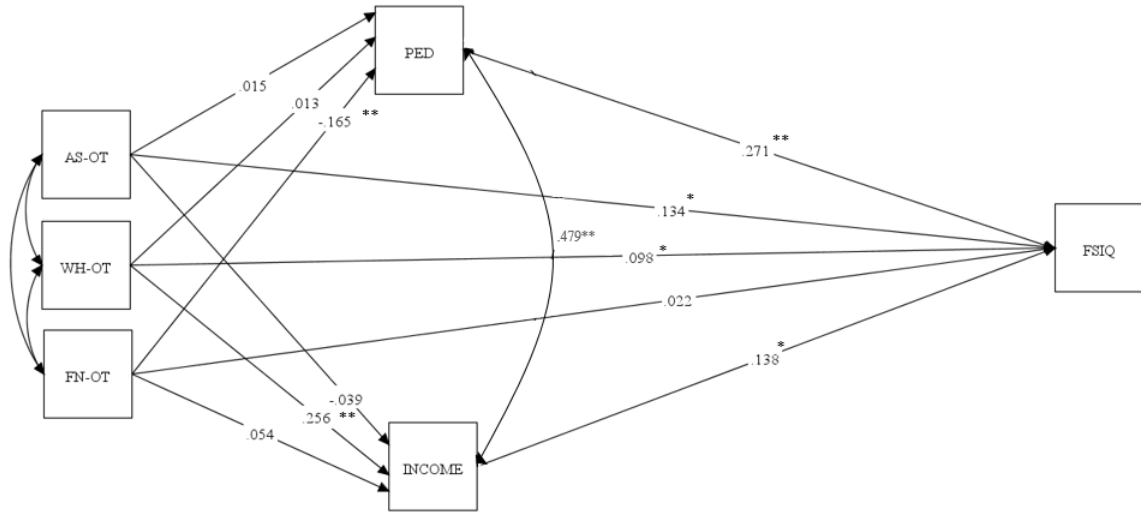
The next path analysis modelled the relation between ethnicity and FSIQ with income as the mediator. This path with standardized coefficients is shown in Figure 5. Significant direct effects between ethnicity and FSIQ were only observed between the AS-OT group. The specific indirect effects for the WH-OT and FN-OT groups were non-significant. The specific indirect effect of WH-OT group however was significant,  $b = .070$ ,  $p = .001$ . This was confirmed as the bias-corrected bootstrap confidence interval did not include zero. This suggests that income level significantly mediated the relationship between ethnicity and FSIQ for the difference between the White and Other group, however, did not for the other two ethnicity comparison groups. This partially supports the initial hypothesis.



**Figure 5.** Path diagram of income as a mediator in the relation between ethnicity and FSIQ. All reported values are standardized coefficients. \*\* $p < .001$ , \* $p < .05$ . **Specific indirect effects include** AS-OT:  $b = .001$ ,  $p = .984$ ; WH-OT:  $b = .070$ ,  $p = .001$ ; FN-OT:  $b = .016$ ,  $p = .286$ . **Total effects include** AS-OT:  $b = .132$ ,  $p = .004$ ; WH-OT:  $b = .136$ ,  $p = .006$ ; FN-OT:  $b = .131$ ,  $p = .703$ .

### 3.2.5.3 PED and Income as Mediators

The final path analysis modelled the relation between ethnicity and FSIQ with both PED and income as mediators. This path with standardized coefficients is shown in Figure 6. Significant direct effects between ethnicity and FSIQ were observed between all ethnicity groups, apart from the FN-OT group. The indirect effects for the AS-OT and WH-OT groups were non-significant. The indirect effect of FN-OT group was significant,  $b = -.037$ ,  $p < .05$ , again confirmed by the bias-corrected bootstrap confidence interval not including zero. This suggests that PED and income level together significantly mediated the relationship between ethnicity and FSIQ for the difference between the First Nations and Other group, however, did not for the other two ethnicity comparison groups. Again, we see the situation where the total effect is not significant, but indirect effect is for this group.



**Figure 6.** Path diagram of parent education and income as mediators in the relation between ethnicity and FSIQ. All reported values are standardized coefficients. \*\* $p < .001$ , \* $p < .05$ . **Indirect effects include** AS-OT:  $b = -.001$ ,  $p = .949$ ; WH-OT:  $b = .039$ ,  $p = .106$ ; FN-OT:  $b = -.037$ ,  $p < .05$ . **Total effects include** AS-OT:  $b = .132$ ,  $p = .003$ ; WH-OT:  $b = .136$ ,  $p = .003$ ; FN-OT:  $b = .131$ ,  $p = .444$ .

Taken all together, the results from these analyses provide partial support for the hypothesis that SES would significantly mediate the relationship. The results provide evidence to suggest that SES (as measured by parent education and household income) in some racial group comparisons plays a significant role in mediating the relationship between ethnicity and FSIQ. This corresponds well with the findings of the linear regression model which showed that indicators of SES were much more predictive of FSIQ compared to race alone.

## CHAPTER 4: DISCUSSION

### 4. Discussion

The purpose of this study was to gain a better understanding of the demographic influences on intelligence test performance within the Canadian population. Specifically, the objective was to examine if and how certain demographic variables (i.e., race/ethnicity and socioeconomic status) influence children's mean performance on a standardized cognitive ability assessment. This was accomplished using the Canadian WISC-V standardization data to evaluate a representative sample of Canadian children aged 6-16. These data were analyzed using a variety of statistical techniques, including analysis of variance, regression modelling, and path analysis. The results suggest that consistent with previous findings in the American sample, demographic variables play a significant role in intelligence test performance. The findings are discussed below.

#### ***4.1 The influence of Socioeconomic Status on Children's FSIQ***

Before discussing the observed findings regarding SES, it is important to understand the appropriateness of the variables used to measure it. As briefly noted in the methodology, there are differing opinions regarding the ways in which SES should be operationalized in research. However, there is consensus regarding the concept of SES, which is that it is the total of the individual's or family's economic and social position, composed of three indicators: income, education, and occupation. Investigators utilizing SES choose different approaches to measuring it, however *education level* is the most commonly used single indicator of SES (Bradley & Corwyn, 2002). A meta-analysis of

74 independent samples showed a consistent medium to strong SES–education level/academic achievement relation (Sirin, 2005), suggesting education level to be a reliable single proxy for SES. Further, it seems reasonable that educational level is strongly linked to overall SES because it is a more *stable* measure than income or occupation, which have the potential to fluctuate more often. In this way, PED level provides a more “trait” record of SES, while occupation and/or income can be considered as more “state”. All things considered, there was sufficient evidence to use PED level as the primary indicator of SES. Further, another important note regarding PED level is that this is measure of the parent’s current education level, and therefore the current SES status of the child. While higher intelligence in childhood does have a strong correlation with higher SES attained in later life, the nature of this study only allows us to examine the relationship of the child’s *current* SES (by proxy of PED level), and does not allow us to speak to the potential SES that children may attain as a result of their measured intelligence level.

The first analysis presented the influence of SES (as measured by PED level) on FSIQ scores. The one-way ANOVA revealed a significant result overall across groups, and post-hoc analyses allowed for a clear breakdown of group differences. This demonstrated that children in the lowest SES groups (PED 1 and PED 2) had significantly lower FSIQ scores compared to those in higher SES groups (PED 3 and 4). Further, differences were observed between the PED 3 and PED 4 groups, suggesting that higher levels of post-secondary education offer additional advantages. These differences are meaningful, demonstrating a significant increase in children’s IQ for every increased educational category (except between PED 1 and 2). These are not trivial differences, as

the mean FSIQ difference between the lowest and highest PED groups was 14.71; this is almost a full standard deviation difference in FSIQ score.

These findings are consistent with results observed in the American WISC-V sample, where higher PED level classifications resulted in significantly higher mean FSIQ in children. Further, these results are consistent with previous literature examining SES and IQ performance using other measurement tools. Therefore, it seems clear that this relationship holds true in the Canadian sample; higher parental education has a significant and positive impact on the cognitive ability performance of their children. With these data, and consistent with previous findings, the child's parental education experience plays a significant role in IQ development and expression. Therefore, if a parent does not have access to education and/or a cognitively stimulating environment, it is possible that they may not have the educational tools to support their child in their intellectual development. This highlights an important issue regarding equal access to education and ensuring that all children have a cognitively stimulating environment.

#### ***4.2 Ethnicity Differences in FSIQ Scores***

Following from U.S. study findings, after socioeconomic status ethnicity was selected as another potential variable that may impact FSIQ performance. The second one-way ANOVA presented the examination of the effect of ethnicity on mean FSIQ performance in the Canadian sample. This again revealed a significant overall difference across groups, and post-hoc analyses allowed for a breakdown of these differences. Specifically, it was demonstrated that the Asian and Caucasian groups scored significantly higher compared to the First Nations and Other groups. Again, this finding



was consistent with the U.S. results in that some race/ethnic groups performed higher on FSIQ than others; however, the racial breakdown of groups between the two countries is vastly different, and therefore specific ethnic group comparison differences were not replicated (nor was this the intention of the study).

#### *4.2.1 Test Bias*

Given the observed score differences among some ethnicity groups, an important concept to address is that of test bias. On the surface, cultural differences in IQ test scores could easily be taken out of context and interpreted as evidence of bias within the test. However, this is not the case. In the early stages of item development for the WISC-V, there is a systematic review of all test items for potential bias by cultural experts. After final items are established, they are reviewed for differential performance across ethnic groups. This analysis of differential item functioning allows one to identify items where subjects from different demographic groups score differently *despite* the same overall ability levels for a construct. Further, construct bias is examined using factor analyses and measurement invariance techniques. If it is shown that subtests are correlated in similar ways across groups, it supports the hypothesis that the same construct is being measured. Finally, while examining mean differences across groups is a simple and direct technique, an alternative approach is to examine how intelligence scores relate to a specific variable across ethnicity groups. Given the established relationship between IQ scores and educational achievement that is consistently observed across cultural groups, this is an ideal candidate. Studies show an absence of differential prediction between achievement and IQ scores across ethnic groups (Poteat, Wuensch, & Gregg, 1988; Reschly & Reschly, 1979; Reynolds & Gutkin, 1980; Reynolds & Hartlage, 1979). Therefore, while

differences in intercepts are observed the slopes are not significantly different. This pattern is also observed in the results of the two-way ANOVA. All things considered, the observed ethnicity group differences here are not evidence for test bias.

#### *4.2.2 Considerations of Ethnicity Differences*

The FSIQ score differences across various ethnicity groups must be interpreted with caution, as there are many additional factors to consider when reading these results. First, these data are based off the study sample matrix that was matched to the census data. The ethnicity variable was crossed across parent education level and geographical region when constructing the sample targets, and therefore the ethnic groups reflect all potential social inequities that exist between the groups naturally in the population. Further, while this study does show some between-group differences based on ethnicity, these data do not prove *the source* of these differences. Supported by Sternberg, Grigorenko, and Kidd (2005) any statements suggesting racial differences in IQ or academic achievement are of *purely* genetic origin is a “leap of imagination.”

Therefore, while ethnicity differences appear in both American and Canadian samples, it seems that this race/ethnicity categorization is most likely a ‘proxy’ for a lot of active mechanisms (e.g., SES, education, differential access). Therefore, it does not seem that these racial/ethnic groups reflect differences in genotypic ability, rather, it is more likely that the differences are a result of differential opportunity for development of cognitive abilities, and a question of environmental differences, rather than genetic ones.

### ***4.3 The Dynamic Interaction between Parent Education Level and Ethnicity***

Next, an interaction hypothesis between SES and ethnicity was tested. The hypothesis was that ethnicity would significantly influence IQ scores in the lower SES groups (PED 1 and 2), but not in the higher SES groups (PED 3 and 4), suggesting that while ethnic differences are observed, this relationship is driven by the SES of the group. Contrary to initial hypothesis, a significant overall result was not observed.

However, as previously noted, the post-hoc analyses and effect size estimates suggest this is a function of unbalanced cells and insufficient power. The unbalanced cells are the result of the mixed-variable stratification that occurs to generate the census-matched study matrix. This approach is used to ensure that the sample is representative of the Canadian population. However, this resulted in insufficient power to detect the interaction. In this case, to accurately assess this hypothesis an oversample or additional sample of cases would need to be collected to address this question adequately.

Despite insufficient power to detect an interaction effect, based on the post-hoc analyses and previous findings in the American sample, it was decided to continue to explore the dynamic relationship of ethnicity and socioeconomic status variables in relation to FSIQ performance. The first analysis addressing this was the linear regression model used to establish the predictive ability of ethnicity, PED, and household income on children's FSIQ performance. The Canadian results replicated those observed in the U.S. study; all three variables were significant predictors of FSIQ. Moreover, the addition of parent education into the model significantly reduced the predictive impact of ethnicity and was the strongest overall predictor of FSIQ performance differences.

As a final examination of this relationship, and mediation analysis was conducted. This was to test the hypothesis that SES would significantly mediate the observed relationship between ethnicity and FSIQ. The results of this analysis provided partial support for this hypothesis, indicating that in some circumstances markers of SES (parent education and income) act as a mediator in the differences observed between ethnicity and FSIQ. This finding provided some additional support for the significant mediation observed in the U.S. studies. However, these studies cannot be equated wholly, as the U.S. study utilized specific ethnic two-group comparisons, and this study utilized a dummy-coded four group comparison.

#### ***4.4 Summary***

Prior to this study, the environmental context of demographic influences on IQ performance had been examined at length in American samples (Weiss et al., 2006; Weiss et al., 2010; Weiss et al., 2015), however, equivalent Canadian examination was severely lacking. This study provides the first analysis of the demographic differences that exist in the Canadian population using the WISC- V<sup>CDN</sup> standardization data. The findings are consistent with previous WISC-IV and WISC-V research done in the U.S., as well as previous literature demonstrating these relations with IQ performance in general (Weiss et al., 2006; Weiss et al., 2015). There were significant and observable differences in FSIQ performance based on demographic variables. These differences serve to increase our understanding of the exogenous environmental impact that demographic differences can have on the development and expression of cognitive ability.

It is clear that home and community environment, as well as parental experiences play significant roles in the development and expression of intelligence. And while not entirely surprising, these differences are not commonly considered in the interpretation of intelligence scores. If a child does not have the physical, social, and emotional environment in which develop these cognitive skills, one of the likely potential outcomes is that their subsequent intelligence performance and academic achievement will suffer. This finding points to an important concept not often considered in performance score interpretation; the effects of poverty on cognitive development and learning. Not taking this into consideration is an oversight, as the effects are widespread, from physical health and psychological well-being, to impacting cognitive development. Poverty also disproportionately effects racial/ethnic groups. This speaks to quality and access of education available to all Canadian people, of all ethnic, cultural, and socioeconomic backgrounds. Therefore, from education planning and policy perspective, these data can help to better support children at an increased risk for lacking environmental stimulation.

#### ***4.5 Strengths***

This study was the first specific examination of demographic differences within the Canadian population, allowing for a targeted examination of specific environmental differences on FSIQ performance. This addressed a significant gap in the research that has existed over the past decade where research focused on U.S. samples alone. There are large, as well as subtle, cultural, social, and economic differences between the countries, therefore it was important that was addressed specifically within Canada. The findings allow for informed and evidence-driven conclusions about the Canadian population.

A considerable strength of this study was the sample data. These data came from a large-scale nationally representative standardization, stratified to match the Canadian population. This allows researchers to be confident that the nature of the findings has external validity and can be applied to majority of testing scenarios in Canada. In addition to its widespread representation of the Canadian population, a fundamental goal of the data collection was to obtain an accurate representation of the First Nations population. This is a group that is often underrepresented in Canadian assessment discussion overall, and who have been underrepresented in past Wechsler assessments. To do this, First Nations communities across Canada were invited to participate, and over 90% of the First Nations sampling target was met in the overall sample. The child's reserve status was also collected to determine whether the child lived on or off reserve. According to Statistics Canada (2006), approximately 46% of Indigenous children 14 and under live on reserve. These numbers are similar to the 2011 NHS report, stating that of the First Nations people with registered Indian status, approximately one half (49%) live on a reserve or settlement (Statistics Canada, 2011). This division of reserve status aligns with the study sample collected. Overall, 42% of children lived on reserve, and 58% either lived off reserve or did not specify (12% not specified). Ensuring the First Nations sample is aligned with the national population strengthens the representativeness of the sample. There are different educational, social, and economic opportunities for those living on reserve, compared with their First Nation peers living off reserve and with other non-Indigenous children in the normative sample, which may relate to their performance on measures of ability and achievement.

Finally, the age group assessed by this study represents a key developmental stage for expression and development of cognitive abilities. This assessment tests children aged 6-16. As previously noted, the evidence suggests that while IQ is not entirely fixed, stabilization of intelligence expression occurs in childhood. This study allowed for an examination of the external influences on intelligence expression in childhood. This is the most important window of opportunity for development and support.

#### ***4.6 Limitations and Future Directions***

While this study demonstrated considerable strengths, it is not without its limitations. First, within the study sample itself an important note is that the First Nations group is not representation of all Indigenous peoples of Canada. Others, including the Métis and Inuit were not specifically sampled. Further, the inclusion of children with specific disability status may not have been representative of the Canadian population. As previously discussed, the prevalence rates are unclear. For future studies, it is important to include a wider selection of Indigenous peoples in the sample. Further, a special group study capturing children with disability classifications would strengthen the findings.

Next, using the WISC-V<sup>CDN</sup> assessment results in potential bias of the testing paradigm. As with most major intelligence tests, there is an emphasis on literacy, and a stimulus-response paradigm is used. This testing paradigm assumes children will: try their best, give relevant answers, ask when unclear, and answer questions in front of a stranger. This may not be the case for all children based on cultural or social differences, and is therefore a limitation here and across the majority of intelligence testing overall.

Finally, in terms of the study methodology, the grouping of the sample by cross-referencing stratification variables is not without a cost. For development of intelligence tests, traditionally SES, race/ethnicity, age, sex, and region of the country are used. Although it allows for a representative sample of the population, parent education levels vary systematically by racial/ethnic group, and are associated with substantial differences in mean FSIQ scores for children. Further, these variables may act singly, but there also may be complex interactions such that race/ethnicity may be masking other underlying variables. We see further limitations of this stratification approach in the PED x Ethnicity interaction analyses. Due to the specific cross-stratification of variables, some study cells were extremely small, and there were drastically unbalanced cells. For future studies examining the effect of this interaction in Canadian data, an oversample of these cells would be required to adequately address this interaction effect.

Going forward, the need for additional sampling of specific groups is clear. However, there are also additional avenues to explore in response to study findings. First, we see the importance of parental education on children's FSIQ performance. Therefore, in future investigation it would be interesting to explore parental support in terms of motivation and encouragement of the child's academic and cognitive development. While at the mean level there are differences evident across the parent education level, perhaps the personality and behavioural characteristics of parents with regard to support and encouragement might offer a protective effect over lower education level status.

Further, in terms of ethnicity differences, another future direction to be explored is the linguistic diversity that might exist between and within a specific ethnicity group, and how this impacts performance. Some ethnicity groups may be more likely to be bilingual



than others, and within the ethnic group there could be more or less diversity in terms of language exposure. While inclusion in the WISC-V sample requires English be the first language and/or the most dominant language, the influence of language on cognitive or achievement test performance has not been adequately investigated.

#### ***4.7 Final Conclusions and Implications***

The WISC- V<sup>CDN</sup> is used across the country to assist in identification of intellectual disability, giftedness, and learning disorders. Therefore, providing interpretive clarity has substantial value to both the psychological and educational communities, and the findings have significant implications not only for clinicians, but for society as well.

From a clinical assessment perspective, the results from this and previous studies showing the impact of demographic differences on intelligence test scores have implications for psychologists engaged in the assessment of intelligence and cognitive abilities. The impact of environmental factors, including those demographic factors examined here, on intellectual development must be factored into the interpretation of intelligence test data. This study adds to a compelling research literature showing that intelligence test scores are impacted by such key factors as ethnicity and parent education. Thus, rather than viewing IQ test scores and more so, intelligence, as immutable, these factors have an impact on both the development and manifestation of intelligence reflected in IQ scores and are significant factors in describing the person being assessed.

These clinical implications speak also to a broader influence in the Canadian educational framework, and argue for societal change. Regardless of ethnic group, higher education and increased environmental opportunity yields higher performance in children. The findings highlight important issues regarding potential access to education and promoting support in at-risk communities. Given the widespread influence cognitive ability has on later life outcome and opportunities, it is critical that these findings are considered at the funding and policy levels which in turn supports the creation and access to the most effective environments for children. This will enable us as a society to provide the necessary support to promote healthy cognitive development in Canadian children across all ethnicities, abilities, and social status.

## REFERENCES

- Ackerman, P. L., Bowen, K. R., Beier, M. E., & Kanfer, R. (2001). Determinants of individual differences and gender differences in knowledge. *Journal of Educational Psychology, 93*, 797–825.
- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Association
- American Psychiatric Association. (2000). Diagnostic and statistical manual of mental disorders (4th ed., text revision). Washington, DC: Author.
- Beal, A. L. (1988). Canadian content in the WISC–R: Bias or jingoism. *Canadian Journal of Behavioural Science, 20*, 154-166.
- Bouchard, T. J., & McGue, M. (1981). Familial studies of intelligence: A review. *Science, 212*(4498), 1055-1059.
- Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual review of psychology, 53*(1), 371-399.
- Bronfenbrenner, U., & Ceci, S. J. (1994). Nature–nurture reconceptualized in developmental perspective: A bio-ecological model. *Psychological Review, 101*, 568–586.
- Burhan, N. A. S., Mohamad, M. R., Kurniawan, Y., & Sidek, A. H. (2014). The impact of low, average, and high IQ on economic growth and technological progress: Do all individuals contribute equally? *Intelligence, 46*, 1–8.
- Chamorro-Premuzic, T., & Furnham, A. (2005). *Personality and intellectual competence*. Mahwah, NJ: Lawrence Erlbaum

- Clarke, A. D. B., & Clarke, A. M. (1984). Constancy and change in the growth of human characteristics. *Journal of Child Psychology and Psychiatry*, 25(2), 191-210.
- Costa, P. T., Jr., & McCrae, R. R. (1992). Revised NEO personality inventory (NEO-PI-R) and NEO Five-Factor inventory (NEO-FFI). Professional manual. Odessa, FL: Psychological Assessment Resources
- Curran, P. J., West, S. G., & Finch, J. F. (1997). The robustness of test statistics to non-normality and specification error in confirmatory factor analysis. *Psychological Methods*, 1, 16-29.
- Deary, I. J., Strand, S., Smith, P., & Fernandes, C. (2007). Intelligence and educational achievement. *Intelligence*, 35(1), 13–21.
- Deary I.J., Whalley L.J., & Starr J.M. (2003) *IQ at Age 11 and Longevity: Results from a Follow- Up of the Scottish Mental Survey 1932*. In: Finch C.E., Robine JM., Christen Y. (eds) *Brain and Longevity. Research and Perspectives in Longevity*. Springer, Berlin, Heidelberg.
- Deary, I. J., Whiteman, M. C., Starr, J. M., Whalley, L. J., & Fox, H. C. (2004). The impact of childhood intelligence on later life: Following up the Scottish mental surveys of 1932 and 1947. *Journal of Personality and Social Psychology*, 86(1), 130–147.
- Flanagan, D. P., & Kaufman, A. S. (2009). *Essentials of WISC-IV assessment* (2nd ed.). Hoboken, NJ: Wiley
- Gale, C. R., Deary, I. J., Boyle, S. H., Barefoot, J., Mortensen, L. H., & Batty, G. D. (2008). Cognitive ability in early adulthood and risk of 5 specific psychiatric disorders in middle age: The Vietnam experience study. *Archives of General Psychiatry*, 65(12), 1410–1418. <http://dx.doi.org/10.1001/archpsyc.65.12.1410>.

- Georgas, J., Weiss, L. G., Van de Vijver, F. J., & Saklofske, D. H. (Eds.). (2003). *Culture and children's intelligence: Cross-cultural analysis of the WISC-III*. Academic Press.
- Gottfredson, L. S. (1997). Mainstream science on intelligence: An editorial with 52 signatories, history, and bibliography. *Intelligence* 24, 13–23.
- Gottfredson, L. S. (2002). Where and why g matters: Not a mystery. *Human performance*, 15(1-2), 25-46.
- Gottfredson, L. S., & Deary, I. J. (2004). Intelligence Predicts Health and Longevity, but Why? *Current Directions in Psychological Science*, 13(1), 1–4.  
<https://doi.org/10.1111/j.0963-7214.2004.01301001.x>
- Gottfredson, L. S., & Saklofske, D. H. (2009). Intelligence: Foundations and issues in assessment. *Canadian Psychology/Psychologie canadienne*, 50(3), 183–195.
- Hayes, A. F., & Preacher, K. J. (2014). Statistical mediation analysis with a multicategorical independent variable. *British Journal of Mathematical and Statistical Psychology*, 67(3), 451-470.
- Hetherington, E.M., Reiss, D., & Plomin, R. (Eds.). (1994). *Separate social worlds of siblings: The impact of nonshared environment on development*. Hillsdale, NJ: Erlbaum.
- Holmes, B. J. (1981). *Individually-administered intelligence tests: An application of anchor test norming and equating procedures in British Columbia* (Educational Research Institute of British Columbia Report No. 81, p. 11). Vancouver, Canada: Educational Research Institute of British Columbia.

- Human Resources and Skills Development Canada. (2011). *Disability in Canada: A 2006 Profile*. Retrieved from [http://www.esdc.gc.ca/eng/disability/arc/disability\\_2006.shtml](http://www.esdc.gc.ca/eng/disability/arc/disability_2006.shtml)
- IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.
- Jencks, C. (1979). *Who gets ahead?: The determinants of economic success in America*. New York, NY: Basic Books.
- Jensen, A. R. (1998). *The g Factor: The Science of Mental Ability*. New York: Praeger
- Jensen, AR. (1969). *How Much Can We Boost IQ and Scholastic Achievement?* Harvard Educational Review 39:1-123.
- Jones, H. E., & Bayley, N. (1941). The Berkeley growth study. *Child development*, 167-173.
- Kline, R. B. (2016). Principles and practice of structural equation modeling. Fourth Edition. The Guilford Press.
- Karbach, J., Gottschling, J., Spengler, M., Hegewald, K., & Spinath, F. M. (2013). Parental involvement and general cognitive ability as predictors of domain-specific academic achievement in early adolescence. *Learning and Instruction*, 23, 43-51.
- Kuncel, N.R., Ones, D.S., & Sackett, P.R. (2010). Individual differences as predictors of work, educational, and broad life outcomes. *Personality and Individual Differences*, 49, 331- 336.
- Laidra, K., Pullmann, H., & Allik, J. (2007). Personality and intelligence as predictors of academic achievement: A cross-sectional study from elementary to secondary school. *Personality and individual differences*, 42(3), 441-451.

Lynn, R. (2012). IQs predict differences in the technological development of nations from 1000 BC through 2000 AD. *Intelligence*, 40(5), 439-444.

Maulik, P. K., Mascarenhas, M. N., Mathers, C. D., Dua, T., & Saxena, S. (2011). Prevalence of intellectual disability: A meta-analysis of population-based studies. *Developmental Disabilities*, 32, 419–436. doi: 10.1016/j.ridd.2010.12.018

McVicker Hunt, J. (1961). *Intelligence and experience*. Oxford, England: Ronald.

Moffitt, T. E., Caspi, A., Harkness, A. R., & Silva, P. A. (1993). The natural history of change to intellectual performance: Who changes? How much? Is it meaningful? *Journal of Child Psychology and Psychiatry*, 34(4), 455-506.

Neisser, U. (1979). The concept of intelligence. *Intelligence*, 3(3), 217-227.

Neisser, U., Boodoo, G., Bouchard Jr, T. J., Boykin, A. W., Brody, N., Ceci, S. J., Halpern, D.F., Loehlin, J.C., Perloff, R., Sternberg, R.J., & Urbina, S. (1996). Intelligence: Knowns and unknowns. *American psychologist*, 51(2), 77.

Nelson, J. M., Canivez, G. L., & Watkins, M. W. (2013). Structural and incremental validity of the Wechsler Adult Intelligence Scale–Fourth Edition with a clinical sample. *Psychological Assessment*, 25(2), 618.

O’Conner, M. C., & Paunonen, S. V. (2007). Big Five personality predictors of post-secondary academic performance. *Personality and Individual Differences*, 43, 971–990.

Plomin, R., & Petrill, S. A. (1997). Genetics and intelligence: What's new? *Intelligence*, 24(1), 53-77.

Poteat, G. M., Wuensch, K. L., & Gregg, N. B. (1988). An investigation of differential prediction with the WISC–R. *Journal of School Psychology*, 26, 59–68.

- Prifitera, A., Saklofske, D. H., & Weiss, L. G. (2008). *WISC-IV clinical assessment and intervention*. Elsevier.
- Raven, J. (1981). *Manual for Raven's progressive matrices and mill hill vocabulary scales*. Oxford: Oxford Psychologists Press.
- Reschly, D. J., & Reschly, J. E. (1979). Validity of WISC-R factor scores in predicting achievement and attention for four sociocultural groups. *Journal of School Psychology, 17*, 355–361.
- Reynolds, C. R., & Kamphaus, R. W. (2004). *Behavior Assessment System for Children*, 2nd ed. Bloomington, MN: Pearson.
- Reynolds, C. R., & Gutkin, T. B. (1980). Stability of the WISC-R factor structure across sex at two age levels. *Journal of Clinical Psychology, 36*, 775–777.
- Reynolds, C. R., & Hartlage, L. C. (1979). Comparison of WISC and WISC-R regression lines for academic prediction with black and white referred children. *Journal of Consulting and Clinical Psychology, 47*, 589–591.
- Rindermann, H. (2012). Intellectual classes, technological progress and economic development: The rise of cognitive capitalism. *Personality and Individual Differences, 53*(2), 108–113.
- Rindermann, H., & Thompson, J. (2011). Cognitive Capitalism: The Effect of Cognitive Ability on Wealth, as Mediated Through Scientific Achievement and Economic Freedom. *Psychological Science, 22*(6), 754–763.
- Roberts, B. W., Kuncel, N. R., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The comparative predictive validity of personality traits, SES, and cognitive ability. *Perspectives on Psychological Science, 2*, 331–345.



- Rushton, J. P. (1996). *Race, evolution, and behavior: A life history perspective*. Transaction Publishers.
- Saklofske, D. H., Patterson, C. A., Gorsuch, R. L., & Tulskey, D. S. (2001). Discussing the guidelines for using the WAIS-III Canadian norms. In D. Wechsler (Ed.), *Wechsler Adult Intelligence Scale* (3<sup>rd</sup> Canadian ed., pp. 35-41). Toronto, Ontario, Canada: Harcourt Canada.
- Schmitt, N., Sacco, J. M., Ramey, S., Ramey, C., & Chan, D. (1999). Parental employment, school climate, and children's academic and social development. *Journal of Applied Psychology*, 84(5), 737-753.
- Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of educational research*, 75(3), 417-453.
- Spearman, C. (1927). The abilities of man.
- Squalli, J., & Wilson, K. (2014). Intelligence, creativity, and innovation. *Intelligence*, 46, 250-257.
- Statistics Canada. (2013). *2011 National Household Survey Profile*. Statistics Canada Catalogue no. 99-004-XWE. Ottawa, Ontario.
- Stenberg, R.J., & Grigorenko, E. (Eds.). (1996). *Intelligence: Heredity and environment*. New York: Cambridge University Press.
- Sternberg, R. J., Grigorenko, E., & Bundy, D. A. (2001). The predictive value of IQ. *Merrill-Palmer Quarterly*, 47(1), 1-41.
- Thorndike, R. L., Hagen, E., & France, N. (1986). *Cognitive abilities test second edition: Administration Manual*. Windsor: NFER-Nelson.

- Tulsky, D. S. (2003). *Clinical interpretation of the WAIS-III and WMS-III*. Academic Press.
- Tulsky, D. S., Saklofske, D. H., & Zhu, J. (2003). Revising a standard: An evaluation of the origin and development of the WAIS-III. *Clinical interpretation of the WAIS-III and WMS-III*, 43-92.
- Vernon, P. E. (1969). *Intelligence and Cultural Environment*. Routledge.
- Vernon, P. A. (1993). *Biological approaches to the study of human intelligence*. Ablex Publishing Corporation.
- Watkins, M. W., & Beaujean, A. A. (2014). Bifactor structure of the Wechsler Preschool and Primary Scale of Intelligence—Fourth Edition. *School Psychology Quarterly*, 29(1), 52.
- Wechsler, D. (1996). *Wechsler Intelligence Scale for Children* (3rd Canadian ed.). Toronto, Ontario, Canada: Harcourt Brace.
- Wechsler, D. (1997). *Wechsler Adult Intelligence Scale* (3rd ed.). San Antonio, TX: The Psychological Corporation
- Wechsler, D. (2001). *Wechsler Adult Intelligence Scale* (3rd Canadian ed.). Toronto, Ontario, Canada: Harcourt Canada.
- Wechsler, D. (2003). *Wechsler intelligence scale for children* (4th ed.). San Antonio, TX: Pearson.
- Wechsler, D. (2008). *Wechsler adult intelligence scale* (4th ed.). Bloomington, MN: Pearson.
- Wechsler, D. (2014). *Wechsler intelligence scale for children* (5th ed.). Bloomington, MN: Pearson.

- Wechsler, D. (2014b). *Wechsler Intelligence Scale for Children* (5th Canadian ed.). Toronto, Ontario, Canada: Pearson.
- Weeks, M., Wild, T. C., Ploubidis, G. B., Naicker, K., Cairney, J., North, C. R., & Colman, I. (2014). Childhood cognitive ability and its relationship with anxiety and depression in adolescence. *Journal of Affective Disorders*, 152, 139–145. <https://doi.org/10.1016/j.jad.2013.08.019>
- Weiss, L. G., Locke, V., Pan, T., Harris, J. G., Saklofske, D. H., & Prifitera, A. (2015). WISC-V Use in Societal Context. In *WISC-V Assessment and Interpretation: Scientist-Practitioner Perspectives*, (pp. 123-185). Academic Press.
- Weiss, L. G., Saklofske, D. H., Coalson, D., & Raiford, S. E. (Eds.). (2010). *WAIS-IV clinical use and interpretation: Scientist-practitioner perspectives*. Academic Press.
- Weiss, L. G., Saklofske, D. H., Prifitera, A., & Holdnack, J. A. (2006). *WISC-IV advanced clinical interpretation*. Academic Press.
- Weiss, L. G., Saklofske, D. H., Holdnack, J. A., & Prifitera, A. (2015). *WISC-V assessment and interpretation: Scientist-practitioner perspectives*. Academic Press.
- Whalley, L. J., & Deary, I. J. (2001). Longitudinal cohort study of childhood IQ and survival up to age 76. *British Medical Journal*, 322(7290), 819.
- Wickett, J. C., Vernon, P. A., & Lee, D. H. (2000). Relationships between factors of intelligence and brain volume. *Personality and Individual Differences*, 29(6), 1095-1122.
- Wraw, C., Deary, I. J., Der, G., & Gale, C. R. (2016). Intelligence in youth and mental health at age 50. *Intelligence*, 58, 69–79.

Wrulich, M., Brunner, M., Stadler, G., Schalke, D., Keller, U., & Martin, R. (2014) Forty Years On: Childhood Intelligence Predicts Health in Middle Adulthood. *Health Psychology, 33*(3), 292–296. <https://doi.org/10.1037/a0030727>

Zammit, S., Allebeck, P., David, A. S., Dalman, C., Hemmingsson, T., Lundberg, I., & Lewis, G. (2004). A longitudinal study of premorbid IQ score and risk of developing schizophrenia, bipolar disorder, severe depression, and other nonaffective psychoses. *Archives of general psychiatry, 61*(4), 354-360.

## APPENDIX A

### Demographic Characteristics of the full Standardization Sample

<b>Variable</b>	<b>Characteristic</b>	<b><i>N</i></b>	<b>% in Sample</b>
Sex	Male	435	50.6
	Female	445	49.4
Ethnicity	Caucasian	647	73.5
	Asian	96	10.9
	First Nations	60	6.8
	Other	77	8.8
Parent Education Level	PED 1	51	5.8
	PED 2	183	20.8
	PED 3	375	42.6
	PED 4	271	30.8
Geographic Region	Central	508	57.7
	East	99	11.3
	West	273	31.0
Age (Year: Month)	6:00 – 6:11	80	9.01
	7:00 – 7:11	80	9.01
	8:00 – 8:11	80	9.01
	9:00 – 9 :11	80	9.01
	10:00 – 10:11	80	9.01
	11:00 – 11:11	80	9.01
	12:00 – 12:11	80	9.01
	13:00 – 13:11	80	9.01
	14:00 – 14:11	80	9.01
	15:00 – 15:11	80	9.01
	16:00 – 16:11	80	9.01

## APPENDIX B

### Content and Structure of the WISC-V<sup>CDN</sup>

FULL SCALE				
Verbal Comprehension	Visual Spatial	Fluid Reasoning	Working Memory	Processing Speed
Similarities	Block Design	Matrix Reasoning	Digit Span	Coding
Vocabulary		Figure Weights	Picture Span	Symbol Search
Information	Visual Puzzles	Picture Concepts	Letter-Number Sequencing	Cancellation
Comprehension		Arithmetic		

*Note.* The seven FSIQ subtests are shown in blue, and subtests that may be used as substitutes are in black italics.

PRIMARY INDEX SCALES				
Verbal Comprehension	Visual Spatial	Fluid Reasoning	Working Memory	Processing Speed
Similarities	Block Design	Matrix Reasoning	Digit Span	Coding
Vocabulary	Visual Puzzles	Figure Weights	Picture Span	Symbol Search

ANCILLARY INDEX SCALES				
Quantitative Reasoning	Auditory Working Memory	Nonverbal	General Ability	Cognitive Proficiency
Figure Weights	Digit Span	Block Design	Similarities	Digit Span
Arithmetic	Letter-Number Sequencing	Visual Puzzles	Vocabulary	Picture Span
Information		Matrix Reasoning	Block Design	Coding
Comprehension		Figure Weights	Matrix Reasoning	Symbol Search
		Picture Span Coding	Figure Weights	

*Continued on next page.*

### COMPLEMENTARY INDEX SCALES

Naming Speed	Symbol Translation	Storage and Retrieval
Naming Speed Literacy	Immediate Symbol Translation	Naming Speed Index
Naming Speed Quantity	Delayed Symbol Translation	Symbol Translation Index
	Recognition Symbol Translation	

*Note.* The Naming Speed Index and the Symbol Translation Index scores, required to derive the SRI, are in gray. This serves as a visual reminder that the SRI is derived from these index scores rather than subtest scores

## APPENDIX C

**WISC-V<sup>CDN</sup> Standardization Home Environment Questionnaire***(For Pearson office use only)*

Date Received: \_\_\_\_\_ Test ID#: \_\_\_\_\_ CF ID#: \_\_\_\_\_

**Child Information** (Parent/Guardian fills in this part)

Child's Name: \_\_\_\_\_ Child's Date of Birth: \_\_\_\_\_

Child's Primary Language: \_\_\_\_\_ Child's Sex: ☐ M ☐ F

Date Tested: \_\_\_\_\_

**Parent/Guardian Information** (Parent/Guardian fills in this part—For payment purposes)

Parent's/Guardian's Name: \_\_\_\_\_ Phone #: \_\_\_\_\_

Street: \_\_\_\_\_ City: \_\_\_\_\_

Province: \_\_\_\_\_ Postal Code: \_\_\_\_\_

**Examiner Information** (Examiner fills in this part)

Examiner's Name: \_\_\_\_\_ Examiner's ID#: \_\_\_\_\_

**Introduction:** In this survey, we hope to gather information related to social and cultural factors that will help us to better understand the child's test results. Your responses are strictly confidential. Your name and the child's name will never be associated with any of your responses. Try to answer all the questions as best you can. If you regard a question as too personal, feel free to skip it.

**Directions:** Please circle your answers and include additional information in the spaces provided.

**1. What is your relationship to the child?**

Biological Parent    Grandparent    Foster Parent    Stepparent    Adoptive Parent    Other: \_\_\_\_\_

**2. What is your sex?**

Male    Female

**3. Who does the child live with?** (Circle all that apply.)

Biological Parent(s)    Grandparent(s)    Foster Parent(s)    Stepparent(s)    Adoptive Parent(s)    Other: \_\_\_\_\_

**4. What is your marital status?**

Single    Married    Remarried    Separated    Divorced    Widowed    Other: \_\_\_\_\_

**5. Do you live with the child?**    Y    N**6. How many adults currently live in the child's home?**

1    2    3    4    5    6+

**7. How many other children currently live in the child's home (not counting the child)?**

0    1    2    3    4    5+

**8. How many of each type of sibling does the child have?**

Brothers, stepbrothers, half-brothers	0	1	2	3	4	5+
---------------------------------------	---	---	---	---	---	----

Sisters, stepsisters, half-sisters	0	1	2	3	4	5+
------------------------------------	---	---	---	---	---	----

**PEARSON**

Copyright © 2013 NCS Pearson, Inc. All rights reserved.  
Printed in Canada.

**PsychCorp.**



9. Answer each of the following questions for the child's parents or guardians:							
	Parent/Guardian #1				Parent/Guardian #2		
<b>a. Relationship to child:</b>							
<b>b. Sex</b>	M	F			M	F	
<b>c. Is he/she the child's biological parent?</b>	Y	N			Y	N	
<b>d. Does he/she live in the child's home?</b>	Y	N			Y	N	
<b>e. Does he/she usually speak English to the child?</b>	Y	N			Y	N	
<b>f. Age</b>	_____ years				_____ years		
<b>g. How many hours per week does he/she work?</b>	_____ hours				_____ hours		
<b>h. What is the highest level of education that he or she completed? (Choose from list below)</b>							
1. Less than high school	5. Bachelor's degree			_____			
2. High school/Equivalent	6. Graduate certificate			_____			
3. High school, some college	7. Master's degree			_____			
4. College diploma	8. Doctorate (e.g., MD, PhD)			_____			
<b>i. Which category best describes his/her line of work?</b> (If more than one category, choose the primary line of work.)							
1. Management	13. Building Maintenance			_____			
2. Business/Finance	14. Personal Care and Service			_____			
3. Computer/Math	15. Sales			_____			
4. Architecture/Engineering	16. Administrative Support			_____			
5. Life/Physical/Social Sciences	17. Farming/Fishing/Forestry			_____			
6. Community/Social Service	18. Construction			_____			
7. Legal	19. Repair/Maintenance Service			_____			
8. Education/Library Services	20. Industrial/Manufacturing			_____			
9. Art/Entertainment/Media	21. Transportation			_____			
10. Healthcare	22. Military			_____			
11. Protective Services	23. Homemaker			_____			
12. Food/Hospitality	24. Other			_____			
<b>10. Was the child born in Canada?</b> Y N If no, how many years has the child lived in Canada? _____							
<b>11. a. Is English the child's first language?</b> Y N If no, specify language: _____							
<b>b. Does the child speak French?</b> Y N							
<b>12. a. Does the child prefer to speak to you in English or French? (circle one)</b>							
<b>b. Does the child prefer to speak to his or her friends in English or French? (circle one)</b>							
<b>c. Does the child prefer to watch TV in English or French? (circle one)</b>							
<b>13. Are any other languages spoken in the home?</b> Y N If yes, please list: _____							
<b>14. How many members of the child's immediate family (parents, brothers, sisters) have been diagnosed with the following problems?</b>							
<b>a. Learning problems/ADHD:</b>	0	1	2	3	4	5	6+
<b>b. Mental health problems:</b>	0	1	2	3	4	5	6+

---

**15. a. Was the child fed breast milk?**      Y      N      (If yes, answer *both* questions [b and c] below.)

**b. How long was the child fed *only* breast milk (with no formula)?**

Does not apply      <1 week      1 week–2 months      3–6 months      7–12 months      13–24 months      24+ months

---

**c. How long was the child fed breast milk *and* formula?**

Does not apply      <1 week      1 week–2 months      3–6 months      7–12 months      13–24 months      24+ months

---

**16. Were there any complications during the pregnancy or delivery?**      Y      N

If yes, specify: \_\_\_\_\_

---

**17. How long did the child remain in the hospital after delivery?**      \_\_\_\_ days      \_\_\_\_ weeks      \_\_\_\_ months

---

**18. a. Circle the number that best describes the type of child care your child received for the majority of his or her waking hours from birth to 1 year.**

1. At the child's home with family member	3. At another home with family member	5. At licensed child care centre
Relationship: _____	Relationship: _____	
2. At child's home with non-family member	4. At licensed home child care	6. At preschool or nursery school

---

**b. Circle the number that best describes the type of child care your child received for the majority of his or her waking hours from 1 year to 2 years.**

1. At the child's home with family member	3. At another home with family member	5. At licensed child care centre
Relationship: _____	Relationship: _____	
2. At child's home with non-family member	4. At licensed home child care	6. At preschool or nursery school

---

**c. Circle the number that best describes the type of child care your child received for the majority of his or her waking hours from 2 years to 3 years.**

1. At the child's home with family member	3. At another home with family member	5. At licensed child care centre
Relationship: _____	Relationship: _____	
2. At child's home with non-family member	4. At licensed home child care	6. At preschool or nursery school

---

**d. Circle the number that best describes the type of child care your child received for the majority of his or her waking hours from 3 years to 4 years.**

1. At the child's home with family member	3. At another home with family member	5. At licensed child care centre
Relationship: _____	Relationship: _____	
2. At child's home with non-family member	4. At licensed home child care	6. At preschool or nursery school

---

**19. Is the child required to be home by a certain time in the evening?**      Y      N

---

**20. a. Does the child have a set bedtime?**      Y      N

**b. If yes, what time does the child go to bed on weekdays?** \_\_\_\_\_ **On weekends?** \_\_\_\_\_

**c. How many hours does the child usually sleep at night?** \_\_\_\_\_

---

**21. How often does the child usually spend time with friends (outside of school)?**

Once a month or less      2–3 times a month      Once a week      Several times a week      Every day

---

**22. How well do you know the child's friends?**

Not at all      Very little      Somewhat      Very well

---

<b>23. How well do you know the parents/guardians of the child's friends?</b>									
Not at all		Very little		Somewhat		Very well			
<b>24. When the child is with friends, how often do you know:</b>									
<b>a. where the child is?</b>									
Never		Rarely		Sometimes		Often		Always	
<b>b. who the child is with?</b>									
Never		Rarely		Sometimes		Often		Always	
<b>25. What type of school does the child attend?</b>									
Public school		Catholic School		Private school		Charter school (Alberta Only)		Online/Virtual School	
Home school									
<b>26. How does the child usually do in school?</b>									
Excellent (A's)		Good (B's)		Average (C's)		Needs Improvement (D's)		Failing (F's)	
<b>27. How many different schools has the child attended from kindergarten until now?</b>									
1		2-3		4-5		6+			
<b>28. a. On average, how many hours per week does the child spend doing homework?</b>									
Less than 1		1-3		4-6		7-9		10+	
<b>b. Does the child do his or her homework at the same time every day?</b>								Y N	
<b>c. Does the child have a quiet spot to do homework?</b>								Y N	
<b>d. Does the child turn off the television/radio/music/Internet when doing homework?</b>								Y N	
<b>29. a. Does an adult in the child's home belong to the Parent-Teacher Association or Home and School Association?</b>								Y N	
<b>b. Does an adult in the child's home attend parent/teacher nights or open houses at school?</b>								Y N	
<b>30. How many days a week does an adult in the child's home:</b>									
<b>a. ask the child if he or she has homework?</b>									
<b>a. ask the child if he or she has homework?</b>									
0		1		2		3		4	
5		6		7					
<b>b. talk to the child about school?</b>									
0		1		2		3		4	
5		6		7					
<b>c. ask to see if the child's homework has been completed?</b>									
0		1		2		3		4	
5		6		7					
<b>d. check to see if the child's homework has been completed correctly?</b>									
0		1		2		3		4	
5		6		7					
<b>e. help the child with homework?</b>									
0		1		2		3		4	
5		6		7					
<b>f. check the child's backpack for notes and assignments from the teacher?</b>									
0		1		2		3		4	
5		6		7					
<b>g. make sure the child's homework is in his or her bag or backpack before leaving for school in the morning?</b>									
0		1		2		3		4	
5		6		7					

<b>31. How many nights per week does the child's family eat dinner together?</b>							
0	1	2	3	4	5	6	7
<b>32. How often does the family spend time together?</b>							
Never	Sometimes	Often	Very often				
<b>33. Does the child's family subscribe to a newspaper or magazine?</b>						Y	N
<b>34. a. How many minutes per day do you spend reading alone for pleasure?</b>							
0–15 minutes		16–30 minutes		31–59 minutes		60+ minutes	
<b>b. How many minutes per day does the <i>child</i> spend reading alone for pleasure?</b>							
0–15 minutes		16–30 minutes		31–59 minutes		60+ minutes	
<b>35. Does the child play a musical instrument?</b> Y N (If yes, answer both questions [a and b] below.)							
<b>a. What instrument?</b> _____							
<b>b. How many hours per week does the child practice playing the instrument?</b>							
0	1–2	3–5	6–9	10+			
<b>36. How many times <i>per month</i> does the child participate in any of the following activities:</b>							
	0	1–2	3–5	6+			
a. sports (e.g., football, dance, karate, swim)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
b. book/reading clubs?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
c. drawing/painting?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
d. YMCA/YWCA/Big Brother/Big Sister/Scouts?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
e. youth fellowship?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<b>37. How many times <i>per year</i> does the child's family participate in the following activities together:</b>							
	0	1–2	3–5	6+			
a. family activities (picnics, games)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
b. educational activities (e.g., museums, zoo, library)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
c. entertainment (e.g., theme parks, movies)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
d. out-of-town vacations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<b>38. How likely is it that the child will:</b>							
	Not Likely	Somewhat Likely	Likely	Very Likely			
a. achieve good grades in school?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
b. graduate from high school?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
c. graduate from college?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
d. graduate from university?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
e. find better employment than yourself?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<b>39. How often does the child receive the following types of encouragement:</b>							
	Never	Sometimes	Often	Very Often			
a. verbal (encouraging words/praise)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
b. physical (e.g., hugs, kisses, patting on head/back)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			

40. How often does the child receive the following types of punishment:		<u>Never</u>	<u>Sometimes</u>	<u>Often</u>	<u>Very Often</u>
a. verbal correction?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. physical discipline?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. time-out?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. lectures/talking to?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. grounding?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. restriction of favourite activities/objects?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

41. a. How many TV sets does the child's family have in the home?		0	1	2	3	4	5+			
b. How many hours per week do you usually watch TV?		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+
c. How many hours per week does the child usually watch educational or informative TV programs?		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+
d. How many hours per week does the child usually watch TV for entertainment (e.g., action, comedy, drama, cartoons)?		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+

42. a. How many video game devices (e.g., Playstation®, iPad®, Xbox®) does the child's family have in the home?		0	1	2	3	4	5+			
b. How many hours per week does the child play video games that involve puzzles, strategy, and/or education?		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+
c. How many hours per week does the child play other types of video games (e.g., action, sports, adventure, simulation)?		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+

43. a. How many computers (laptop or desktop) does the child's family own?		0	1	2	3	4	5+			
b. How many touch-screen devices (e.g., iPad, Kindle®, Nintendo® DS, iPod Touch) does the child's family own?		0	1	2	3	4	5+			
c. How many hours per week does the child use computers or touch-screen devices?		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+

44. a. How many touch-screen phones (e.g., iPhone®, Android®, Blackberry®) does the child's family own?		0	1	2	3	4	5+			
b. Does the child have their own touch-screen phone (e.g., iPhone, Android, Blackberry)?							Y	N		
c. How many hours per week does the child use his or her touch-screen phone?		0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+

45.	a. Does the child have access to computers, tablets, video games, or touch-screen phones outside of the home (e.g., through school or friends)?								Y	N
	b. How many hours per week does the child spend using these devices outside of the home ?									
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+	
46.	Does the child have a social media account (e.g., Twitter®, Facebook®, Instagram®)?								Y	N
47.	How many hours per week does the child use smartphones, tablets, and computers for the following:									
	a. surfing the web for fun?									
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+	
	b. social media (e.g., Facebook, Twitter, or text messaging)?									
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+	
	c. homework or school-related activities?									
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+	
	d. playing games?									
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+	
	e. listening to music/watching movies?									
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+	
	f. creative or artistic activities (e.g., art and photography)									
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15+	
48.	Please rate how well each statement describes the child's attitude toward technology (e.g., computers, touch-screen devices, iPads, video games, smartphones):									
		Strongly Disagree	Somewhat Disagree	Slightly Disagree	Slightly Agree	Somewhat Agree	Strongly Agree			
	a. My child likes using technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
	b. My child easily learns how to use new technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
	c. My child has trouble figuring out new technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
	d. My child uses technology all the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
	e. My child often checks for updates or texts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
	f. My child is confident about using technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
	g. My child wants the latest in technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
	h. My child is slow to learn new technology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
	i. My child is an expert at technology.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
49.	What is the child's family's combined annual income before taxes? (circle one)									
	Under \$9,999	\$10,000–\$14,999	\$15,000–\$19,999	\$20,000–\$29,999						
	\$30,000–\$39,999	\$40,000–\$49,999	\$50,000–\$59,999	\$60,000–\$69,999						
	\$70,000–\$79,999	\$80,000–\$99,999	\$100,000–\$199,999	\$200,000+						

---

**50. a. What type of home does the child's family live in? (circle one)**

Detached house      Semi-detached house      Condo/Apartment      Townhouse      Other: \_\_\_\_\_

---

**b. Does the child's family own or rent the home where the child currently lives?**

Own      Rent      Lives with others

---

**c. If the child's family owns the home where the child lives, what is the current value of that home?**

- ☐ Under \$50,000     
 ☐ \$50,000–\$99,999     
 ☐ \$100,000–\$149,999     
 ☐ \$150,000–\$199,999  
☐ \$200,000–\$249,999     
 ☐ \$250,000–\$299,999     
 ☐ \$300,000–\$349,999     
 ☐ \$350,000–\$399,999  
☐ \$400,000–\$499,999     
 ☐ \$500,000–\$749,999     
 ☐ \$749,000–\$1,000,000     
 ☐ \$1,000,000 +
- 

**51. How many times in the child's life has he or she moved to a different home? (circle one)**

0      1–2      3–4      5–6      7+

---

Please turn the page.

Below are phrases that describe how children may act. Please read each phrase, and circle the response that describes how the child has behaved recently (in the last several months).

Circle **N** if the behaviour **never** occurs.

Circle **S** if the behaviour **sometimes** occurs.

Circle **O** if the behaviour **often** occurs.

Circle **A** if the behaviour almost **always** occurs.

**Please mark every item.** If you don't know or are unsure of your response to an item, give your best estimate.

	<u><b>Never</b></u>	<u><b>Sometimes</b></u>	<u><b>Often</b></u>	<u><b>Always</b></u>
52. Spends time alone in his or her room	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
53. Exercises	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
54. Tries to be healthy	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
55. Prefers to watch TV instead of going outside	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
56. Puts in extra effort at school	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
57. Avoids hard work	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
58. Chooses healthy food	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
59. Likes to try new things	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
60. Has trouble waiting for his or her turn	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
61. Tries to think of interesting ideas	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
62. Is imaginative about solving problems	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
63. Is very motivated to do well in school	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
64. Is easily annoyed by others	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
65. Has a short attention span	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
66. Recovers quickly after a setback	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
67. Disobeys	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
68. Pays attention	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
69. Steals	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
70. Is a "self-starter"	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
71. Listens to directions	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
72. Adjusts well to changes in routine	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
73. Pays attention when being spoken to	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
74. Argues when denied own way	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
75. Lies to get out of trouble	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
76. Sets realistic goals	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
77. Is creative	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
78. Is easily distracted	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
79. Is negative about things	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
80. Adjusts well to changes in family plans	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>
81. Deceives others	<b>N</b>	<b>S</b>	<b>O</b>	<b>A</b>



(continued)

Below are phrases that describe how children may act. Please read each phrase, and circle the response that describes how the child has behaved recently (in the last several months).

Circle **N** if the behaviour **never** occurs.

Circle **S** if the behaviour **sometimes** occurs.

Circle **O** if the behaviour **often** occurs.

Circle **A** if the behaviour almost **always** occurs.

**Please mark every item.** If you don't know or are unsure of your response to an item, give your best estimate.

	<b>Never</b>	<b>Sometimes</b>	<b>Often</b>	<b>Always</b>
82. Sneaks around	N	S	O	A
83. Interrupts others when they are speaking	N	S	O	A
84. Listens carefully	N	S	O	A
85. Lies	N	S	O	A
86. Acts without thinking	N	S	O	A
87. Has trouble making new friends	N	S	O	A
88. Breaks the rules just to see what will happen	N	S	O	A
89. Gets into trouble	N	S	O	A
90. Cannot wait to take a turn	N	S	O	A
91. Is easily upset	N	S	O	A
92. Makes friends easily	N	S	O	A
93. Is easily soothed when angry	N	S	O	A
94. Hits other children	N	S	O	A
95. Breaks the rules	N	S	O	A
96. Changes moods quickly	N	S	O	A
Answer for children aged 12–16 ONLY				
97. Uses foul language	N	S	O	A
98. Is in trouble with the police	N	S	O	A
99. Repeats one activity over and over	N	S	O	A
100. Uses illegal drugs	N	S	O	A
101. Hits other adolescents	N	S	O	A

**Thank you for your participation!**

## APPENDIX D

### General Inclusion Criteria

Children were eligible for inclusion if they met all the following criteria:

- primary language is English;
- able to communicate at a level commensurate with age and diagnosis, and not completely uncommunicative;
- normal hearing and vision (with aid);
- normal fine and gross motor ability (with the exception of mild motor impairment occurring in groups such as the Intellectual Disability group);
- no physical conditions, illnesses, or impairments that could impact cognitive functioning or test performance (with the exception of conditions or impairments associated with the specific special group);
- no diagnosis of a neurological condition (e.g., seizure disorder, epilepsy, encephalitis, brain surgery, brain tumor) other than the condition of interest or as allowed for a given special group;
- no period of unconsciousness not related to surgery or greater than 20 minutes related to a medical condition;
- no diagnosis of intellectual disability (with the exception of the Intellectual Disability subgroups);
- no diagnosis of a psychiatric disorder (e.g., psychotic disorders, mood disorders) other than that defined by the special group criteria;
- not currently admitted to a hospital, inpatient treatment, or psychiatric facility;
- not currently taking medication that might impact test performance, except as appropriate to treat condition of interest or associated conditions;
- has not completed the WISC–IV or any other measure of cognitive ability in the 6 months prior to the testing date.

## APPENDIX E

### Specific Inclusion Criteria for Special Groups

#### *Intellectually Gifted*

- age 6–16;
- full scale score  $\geq 2$  SDs above the mean on a standardized, individually administered measure of cognitive ability (e.g.,  $IQ \geq 130$ ); and
- receiving services for intellectual giftedness in school.

#### *Intellectual Disability*

- age 6–16;

AND

- meets DSM-5 criteria for a current diagnosis of intellectual disability, mild or moderate severity has previously met DSM–IV–TR criteria for a diagnosis of intellectual disability, mild or moderate severity

OR

- full scale score 2–4 SDs below the mean on a standardized, individually administered measure of cognitive ability (e.g.,  $IQ = 40–70$ )

*Note:* Participants must have also met general inclusion criteria as noted in **Appendix D**.

## CURRICULUM VITAE

**Name:** Sarah E. Babcock

**Post-secondary Education and Degrees:** **McMaster University**  
Hamilton, Ontario, Canada  
2006-2010 Hons B.A.

**McMaster University**  
Hamilton, Ontario, Canada  
2010-2012 Certified Clinical Research Associate (CCRA)

**The University of Western Ontario**  
London, Ontario, Canada  
2015-2017 M.Sc

**Honours and Awards:** **McMaster University Deans Honour List:** 2006 – 2010  
Graduated Summa cum laude

**McMaster Senate Scholarship** (\$800); 2007, 2009

**Undergraduate Student Research Award (NSERC)**  
(\$6000), 2009

**University Health Network Academic Achievement Scholarship**  
(\$1500), 2009

**Social Science and Humanities Research Council (SSHRC)**  
**Canada Graduate Scholarship-Master's** (\$17,500), 2016

**Ontario Graduate Scholarship**  
(\$15,000), 2017

**Related Work Experience:** **Teaching Assistant**, McMaster University, 2008-2010

**Research Assistant**, St. Joseph's Hospital, 2008-2009

**Research Assistant**, McMaster University, 2009

**Research Assistant**, McMaster Children's Hospital, 2010

**Sessional Lecturer**, Ryerson University, 2010

**Research Coordinator**, Pearson Canada Assessment, 2010-2015

**Project Coordinator**, Pearson Canada Assessment., 2015-2016

**Teaching Assistant**, The University of Western Ontario, 2015-2017

**Research Assistant**, The University of Western Ontario, 2016-2017

**Publications:** **Babcock, S. E.**, & Wilson, C. A. (*in press*). Big five model of personality. In B. J. Carducci (Editor-in-Chief) & A. Di Fabio, D. H. Saklofske, & C. Stough (Vol. Eds.), *Wiley-Blackwell encyclopedia of personality and individual differences: Vol. III. Personality processes and individual differences*. Hoboken, NJ: John Wiley & Sons.

**Babcock, S.E.**, Wilson, C.A., & Lau, C. (2017). Test Review: School Motivation and learning strategies inventory (SMALSI): College Form. *The Canadian Journal of School Psychology*. DOI: 10.1177/0829573517697532

**Babcock, S.**, Li, Y., Sinclair, V., Thomson, C., & Campbell, L. (2017). Two Replications of an Investigation on Empathy and Utilitarian Judgment across Socioeconomic Status. *Scientific Data*, 4, 160129. <https://doi.org/10.1038/sdata.2016.129>

Saklofske, D.H., Zhu, J., Miller, J.L., Weiss, L.G., **Babcock, S.E.**, Cayton, T.G., Raiford, S.E., & Coalson, D.L. (2012). The Cognitive Proficiency Index for the Canadian Edition of the Wechsler Adult Intelligence Scale–Fourth Edition. *Canadian Journal of Behavioural Science*, 44(2), 117-123.

**Other Research Contributions:** **Babcock, S.E.**, Miller, J.L., & Saklofske, D.H. (2016, June). WISC-V use and interpretation: A Canadian societal perspective. Poster presented at the Canadian Psychological Association Convention, Victoria, B.C., Canada.

**Babcock, S.E.**, Miller, J.L., & Saklofske, D.H. (2016, June). The role of socioeconomic status on reading activities and intelligence scores. Poster presented at the Canadian Psychological Association Convention, Victoria, B.C., Canada.

Altmann, R., Cho, Y., **Babcock, S.**, Patryluk, C., Raiford, S., & Miller. (2015, August). Comparing BASC2-Parent Rating Scales among Canadian and American children with ADHD. Poster presented at the American Psychological Association Convention Toronto, ON, Canada.

**Babcock, S.E.**, Cohen, J.E., & Shedden, J.M. (2009, November). The specificity of error processing in math anxious individuals: An electrophysiological study. Poster presented at the Undergraduate Student Research Award poster session, Hamilton, ON, Canada.